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MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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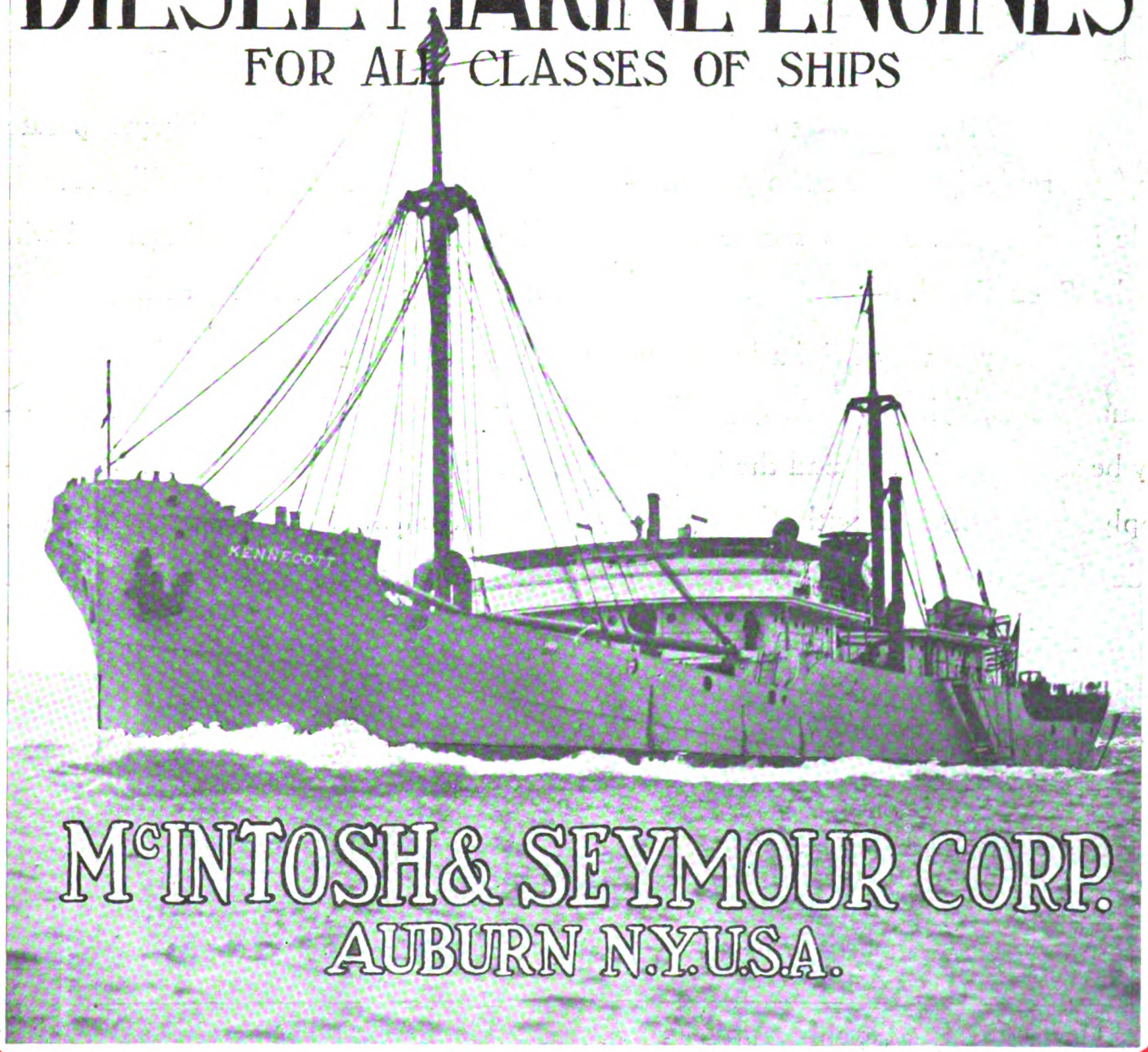
DIESEL MARINE ENGINES
FOR ALL CLASSES OF SHIPS



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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

MOTORSHIP

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PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction.

Vol. VI | New York, U. S. A., July, 1921 | No. 7

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First of the Doxford Motorships

"Yngaren," One of Four 9,350 Tons Deadweight Single-Screw Freighters with 3,000 I. H. P. Low-Speed Solid-Injection Opposed-Piston Oil Engines of New Design

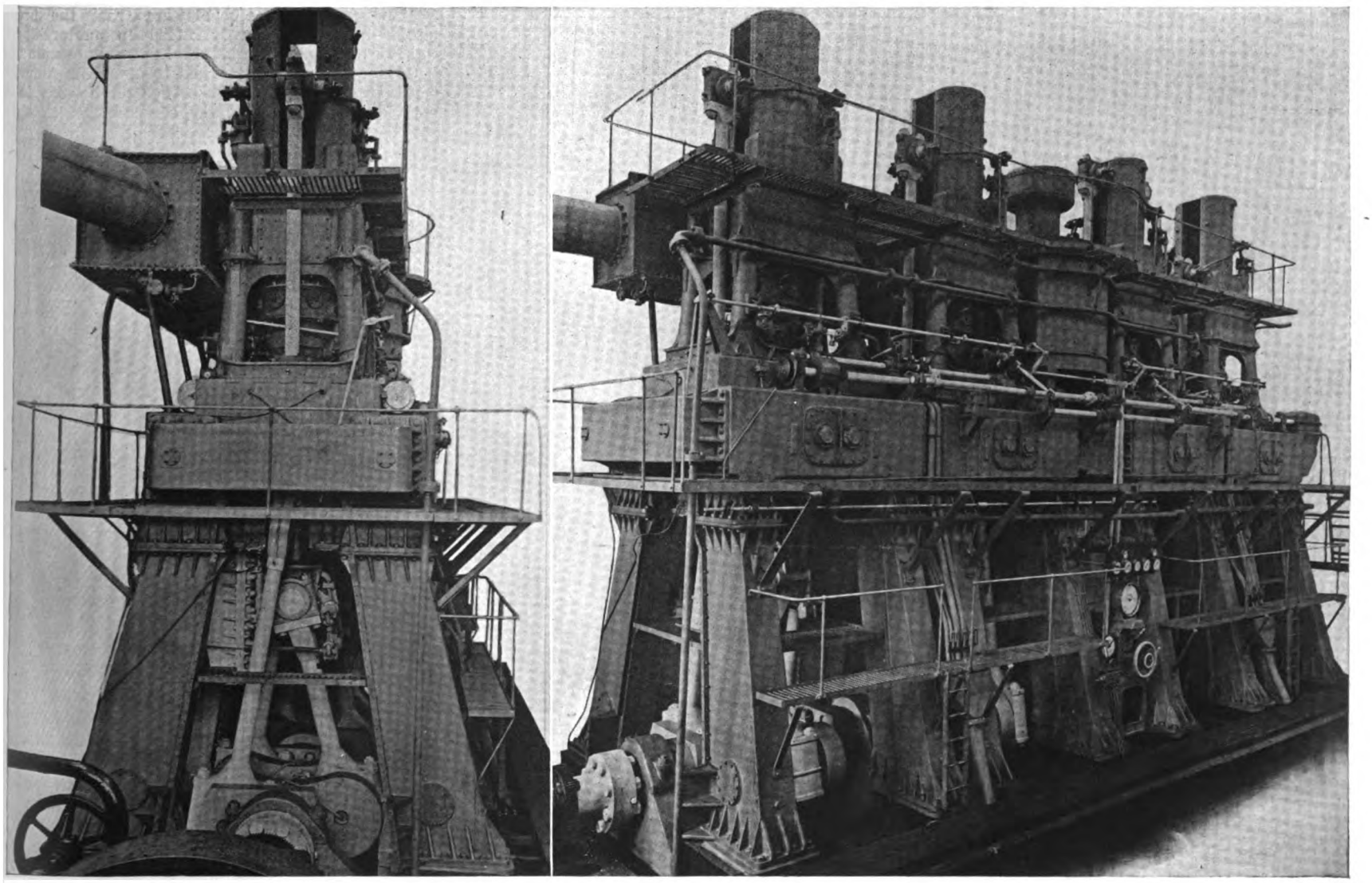
ONE of the most interesting maritime events of the year in the Old World was the recent trial of the new cargo motorship "Yngaren" of the Rederiaktiebolaget Transatlantic of Göteborg, Sweden, built by the English shipbuilding firm of William Doxford & Sons, Ltd., Sunderland. The special interest is in her machinery as she is propelled by the new high-powered, low-speed, medium-compression, mechanical-injection, internal-combustion oil-engine developed by Doxfords from the Junkers-Ochelhauser opposed-piston two-cycle principle from designs by Mr. K. O. Keller. As only about 300 lbs. compression-pressure is used in the working-cylinders, and as the injection of fuel is carried-out by pump-pressure only—no compressed-air being used, this engine cannot accurately be described as following the true "Diesel" principle. That the designers consider it an improvement over the straight Diesel-cycle is indicated in their action of having adopted this design after having constructed and tested a regular single-piston two-cycle Diesel-engine, in addition to a single-cylinder opposed-piston engine of large output. They have been experimenting for eleven years, at an expenditure of over two million dollars; finally resulting in the present engine, which they believe will be a very important factor in the World's merchant marine. Because of its short length and slow-speed it should have particular merits for installations where steamers are to be converted to motor power. Details of the early Doxford experiments were given in "Motorship" for June, 1917.

This shipyard altogether has four large sister motorships under construction including the "Yngaren," of which three are for the Rederi. Transatlantic, and one for the Grindon Steamship Line (B. & J. Sutherland & Co.) of Newcastle-on-Tyne, England. All four are of 9,350 tons d.w.c. and of 3,000 i.h.p. The second motorship for the Transatlantic Co. was recently launched.

The general dimensions are the same, except that the Grindon boat has no deep-tank, and consequently has 10,000 cubic-feet greater hold-capacity. But, as we presume the Transatlantic Co.'s ships will use the deep-tank for either oil-cargo or dry-cargo, and never for fuel purposes, it may be considered that the net-carrying capacities of all these vessels are the same on given voyages.

The dimensions of the "Yngaren" are as follows:

Displacement (loaded)	12,750 tons
Displacement (light)	3,400 tons
Deadweight capacity	9,350 tons
Net cargo-capacity on 10,000 miles voyage (not included fuel, etc.)	8,900 tons
Fuel required on 10,000 miles voyage	360 tons
Fuel-capacity (double bottom)	1,130 tons
Cruising radius	32,000 miles
Cubic capacity of holds	560,000 cu. ft.
Loaded speed	10½ knots
Trial speed	? knots
Power (indicated)	3,000 i.h.p.
Power (shaft)	2,700 b.h.p.
Engine and propeller speed	70 r.p.m.
Daily sea fuel-consumption	9 tons
Daily oil-consumption	16 gallons
Daily port fuel-consumption	1 ton
No. of engine-room and boiler staff	11 men
Length O. A.	435 ft.



End and front views of the 3,000 i.h.p. Doxford two-cycle type opposed-piston marine oil-engine installed in the "Yngaren"

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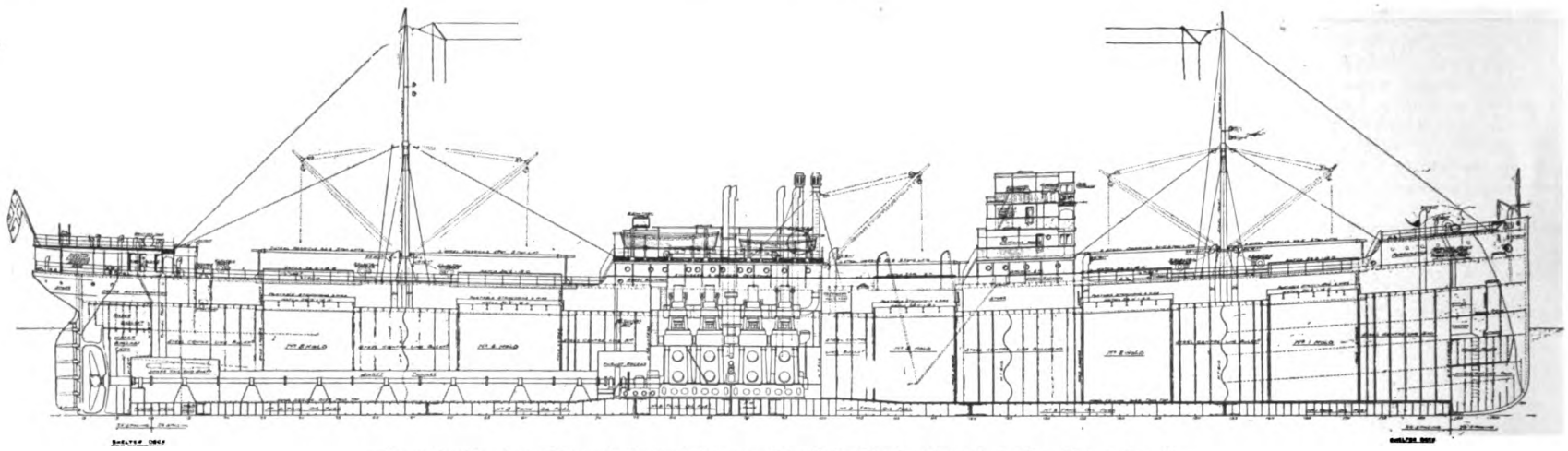
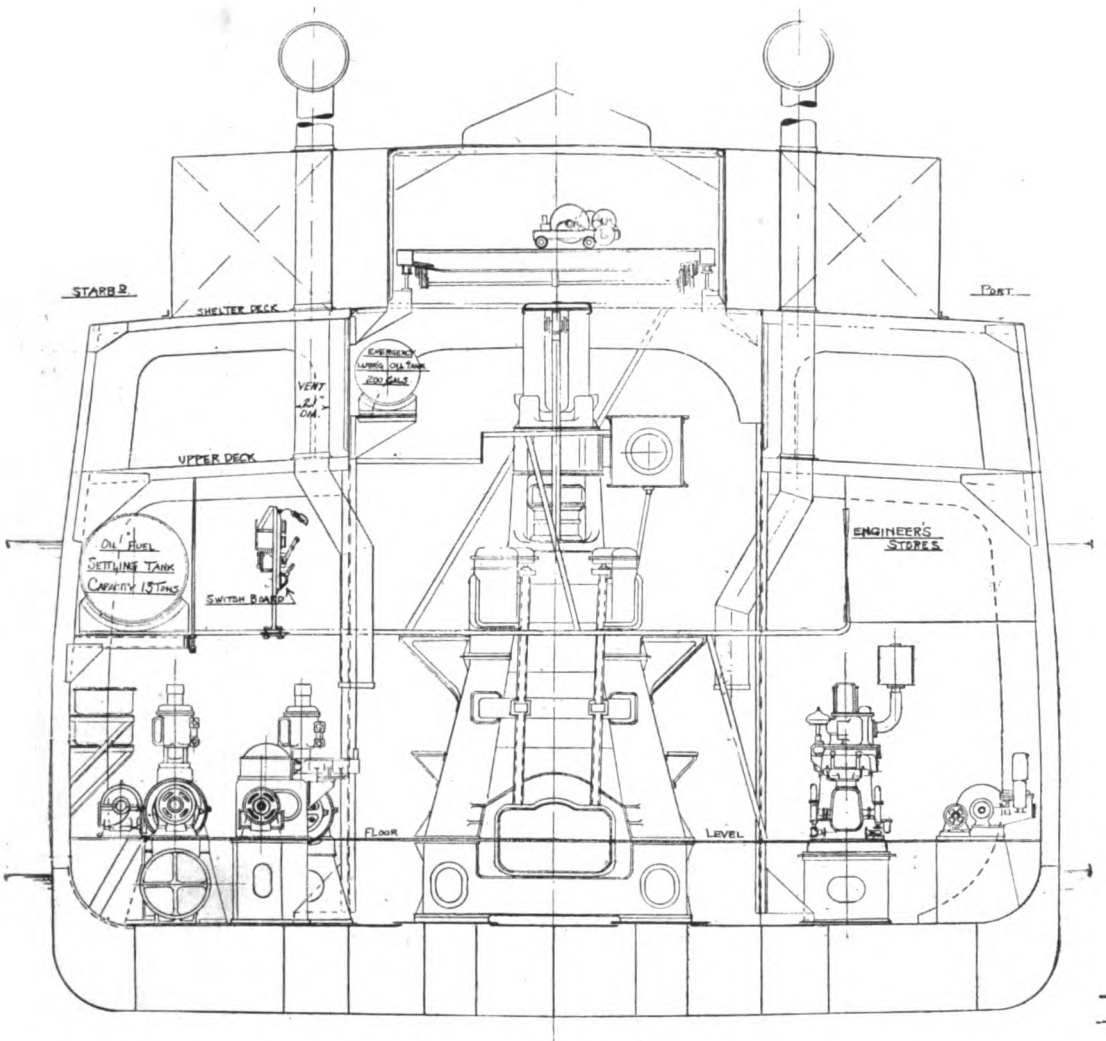


Longitudinal section of Rederi Transatlantic's Doxford motorship "Yngaren."



Section of engine-room of motorship "Yngaren."

Length B. P.....420 ft.
Breadth (extreme) .....54 ft.
Depth M. D. .....29 ft.
Draught (loaded mean) .....25 ft., 6 in.
Cyld. bore and stroke of main engines, 580 mm. (24.84 ins.) by 1,160 mm. (45.66 in.)
Total stroke of both opposed-pistons..7 ft., 1/32 in.
Piston speed .....586 ft. per min.
Weight of main-engines without propeller shafting .....370 tons
Weight of complete engine-room machinery including propellers and shafting.....550 tons
Propeller .....17 ft., 6 in. dia. by 17 ft. pitch and 960 sq. ft. surface area
Length of machinery space .....49 ft., 10 in.

Referring to the fuel-consumption of one ton per day when in port, this low figure is obtained by Diesel-electric auxiliaries; but as the Grindon Line's vessel will have steam-driven auxiliaries, her daily port consumption will be 4 tons, or 400% greater than that of the "Yngaren." At the same time she will carry one man less in the engine-room.

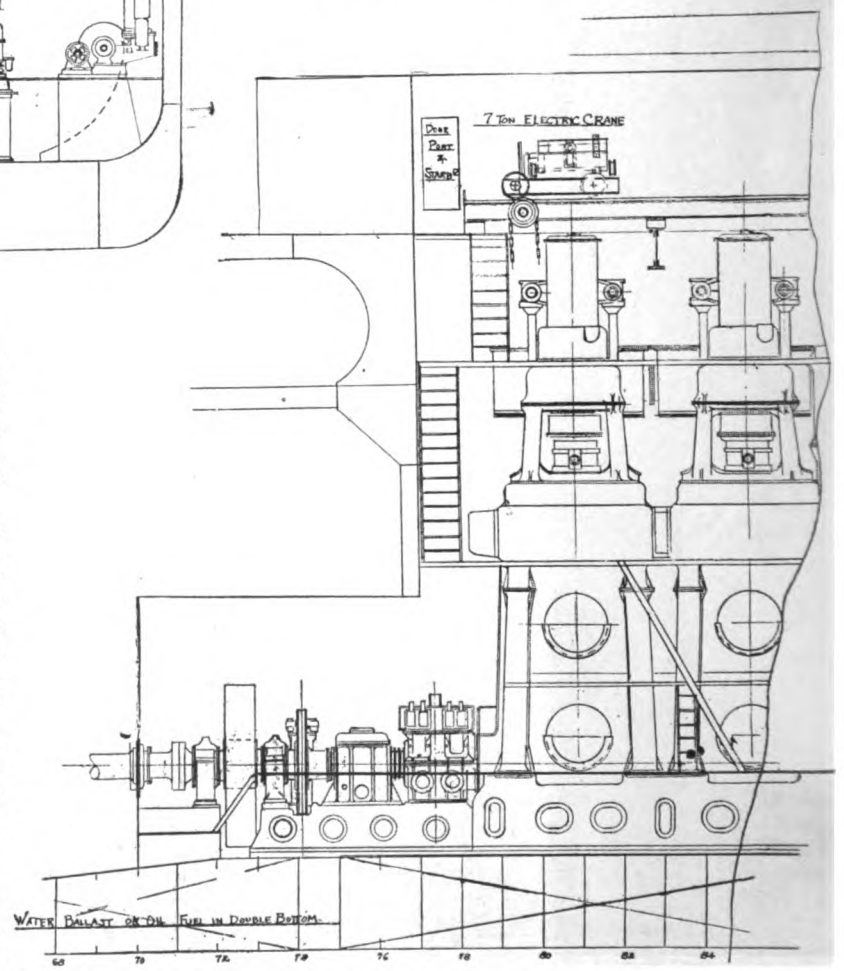
Nevertheless, the "Yngaren" and her sister-motorships will carry one donkey-boiler of 200 sq. ft. for steam-heating the ship and for warming the main engine when starting from cold. The Grindon ship will have two donkey boilers with a total heating-surface of 1,700 sq. ft. At the sides her engine-room length will be 37 ft. long and 49 ft. long in the center.

Sea-trials of the "Yngaren" were run on June 9th and 14th respectively with highly satisfactory results. A mean-speed of 12.83 knots was maintained over the measured-mile during a six hours trial, which was attended by representatives of leading shipowners, who expressed high approval. For a single-screw ship of her power and tonnage the speed is very satisfactory, the guaranteed trial-speed being 12-knots. Obviously the loaded sea-speed of 10½ knots will be easily maintained in service.

In the engine-room of the "Yngaren" there are three 70 K. W. electric generating-sets arranged on the port side and driven by three Doxford 2 cyld. oil-engines. On this side there also are four electric-driven pumps. On the starboard side of the engine-room there are two electrically-driven aid-compressors for manoeuvring the main-engine, one being a spare; two starting-air tanks; a high-pressure fuel-oil pump; cylinder-circulating water-pumps; two force-feed lubricating-oil pumps; oil-fuel transfer-pump, the Cochran donkey-boiler and evaporator for the same; lubricating-oil filters, and the main switchboard. The main high-pressure fuel-oil pump is located at the after end of the propelling-engine, between the latter and the thrust-block and is driven through spur-wheels off the thrust-shaft. Forward of the main engine is a small steam-driven air-compressor and an emergency jacket water-supply tank of 1950 gallons capacity.

An innovation, and a very excellent one at that, is the installation of a 7-ton electric-crane over the main engine to facilitate handling the heavy parts when overhauling and making repairs, should an occasion arise.

Standing-out radically distinct from the propelling-machinery usually fitted in motorships, this Doxford oil-engined ship will be examined with more than usual interest if she visits American waters, and her performance on her maiden voyage will doubtless carry considerable weight



Showing Michell thrust-bearing and pumps between thrust and engine

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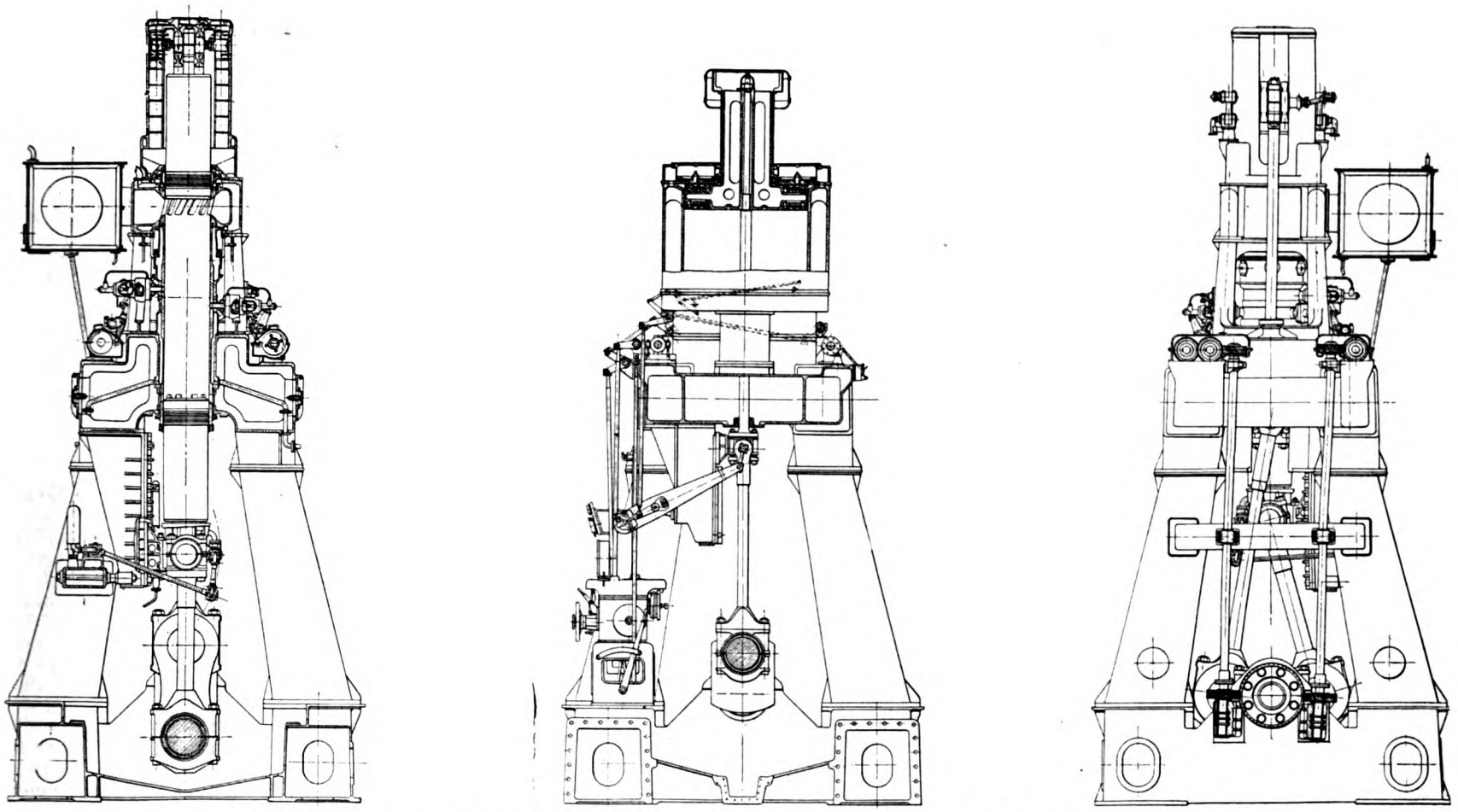
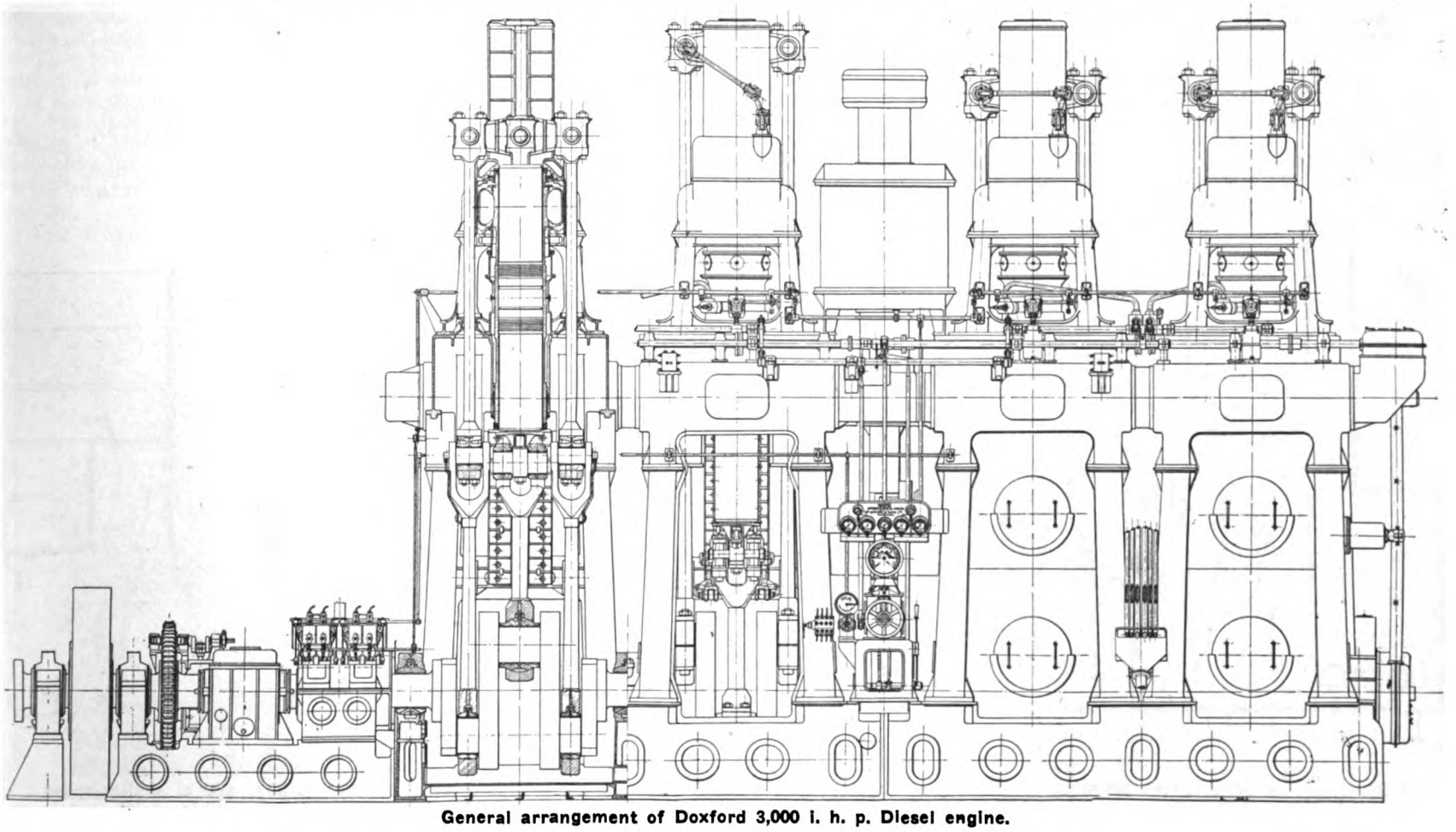


Section of working-cylinder, section of scavenging-pump and end view of Doxford 3,000 i.h.p. engine

with shipowners and shipbuilders in regard to their attitude towards the opposed-piston design. As a matter of fact we hear one prominent shipbuilding concern on the East Coast of the United States is acquiring a license, but we believe that definite construction will largely depend upon the performance of the Doxford ships. As the shipyard in question is closely linked with important oil-interests, it will be realized that the outcome may have considerable bearing upon the development of the motor-tanker in this country.

In this 2,700 shaft h.p. (3,000 i.h.p.) Doxford engine of the "Yngaren" there are no gas-pressure reactions on the main-bearings, no tension stresses in the framing, no bending loads in the bed-plate, negligible shaking forces due to inertia, and no cylinder heads. Owing to the fact that there are two pistons working in each cylinder-barrel, twice as much displacement is secured as in ordinary machines of the same bore and stroke, as though double-acting cylinders had been used. These remarkable results, and the development of 650 brake h.p. on a bore-and-stroke basis which on the usual four-cycle engine would yield at the most 150 brake H.P. per cylinder, have been attained by a thorough-going work-out of the two-cycle principle as applied to the Doxford-Keller design of the well-known Junkers system. The distinguishing features of this arrangement are the use of a set of three-throw cranks between each pair of main-bearings and a pair of oppositely moving pistons of which one is coupled by means of a pair of rods with the outer two cranks standing at the same phase and the other is linked to the center crank standing 180 degrees away from the outer part. When the central cranks is at the bottom dead-center, the outer ones are at the top and a rotation of the crankshaft then produces an upward motion of the



General arrangement of Doxford 3,000 i. h. p. Diesel engine.

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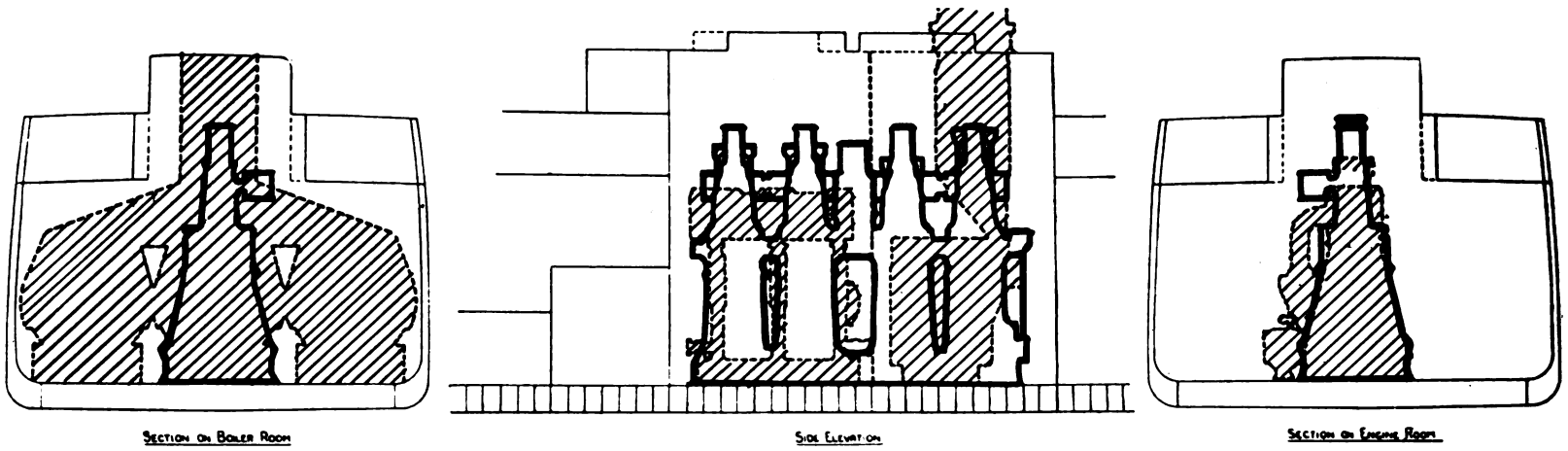


Comparisons between spaces occupied by Doxford oil-engine and triple-expansion steam set of 3,000 I. h. p. and of similar speed. Cylinders of steam-engines are 27 in. by 44½ in. by 75 in. by 54 in. stroke and 71 R. P. M. Overall length of steam machinery 43 ft. 6 in. Overall length of Diesel machinery 42 ft. 7½ in.

lower piston and a downward motion of the upper piston. Whatever air has been caught between the two is then compressed until both pistons have again reached opposite dead-centers.

Since the pressure-load is borne alike by both pistons, no unbalanced force remains for producing stress in the framing, in fact, there is no fixed member corresponding to the cylinder-head of an ordinary engine against which a pressure-load could react. The reaction itself is transmitted through the rods to the crank. Except for connecting-rod angularities, equal and opposite forces must therefore always be applied to the crank-arm and there can be no force left for producing pressure on the main-bearings. Exactly the same considerations apply to the inertia forces and the only static reactions of any consequence that can be discovered anywhere are the hoop-stress in the cylinder-liner and the side-forces at the crosshead shoes. There was a tendency, however, on the part of the early originators of this type of engine in Germany to lay too much stress on these facts and they produced machines which lacked the *sine qua non* of oil-engine success—rigidity. There are a multitude of forces and deflections in oil-engines—varying according to the design—of which keenest reasoning cannot always take account, but which in most cases must be guarded against by a more or less general and universal provision of deep and massive metal sections. A glance at the illustrations of the Doxford-engine makes it apparent that the designers of this machine have given ungrudging recognition to this important lesson of experience.

With the Doxford design all the main direct-stresses are taken by forged members mathematically proportioned with a high degree of certainty. Of these forgings, only the central connecting-rod is subject to compression and the long-rods for the upper piston are always in tension. Since they are applied by means of a toggle-beam, they are insured at all times against unequal load distribution and it is impossible for them to produce undue cocking in the guides of the upper piston.

Although, as we have stated, none but nominal loads are applied to the stationary parts of the engine, its framing, fully illustrated in the photographs and drawings, exhibits the same ruggedness and rigidity as though it had to withstand the same forces that must be allowed for in the usual designs. The bed-plate is of deep section and is well adapted for resisting hull deflections. This is a point which cannot be over-emphasized in the case of engines wherein the bedplate participates in the working-loads, and its careful observance which we find here in an engine structure not exposed to these loads, is highly to be commended. There are four massive buttress-like columns under each cylinder—four over each main-bearing.

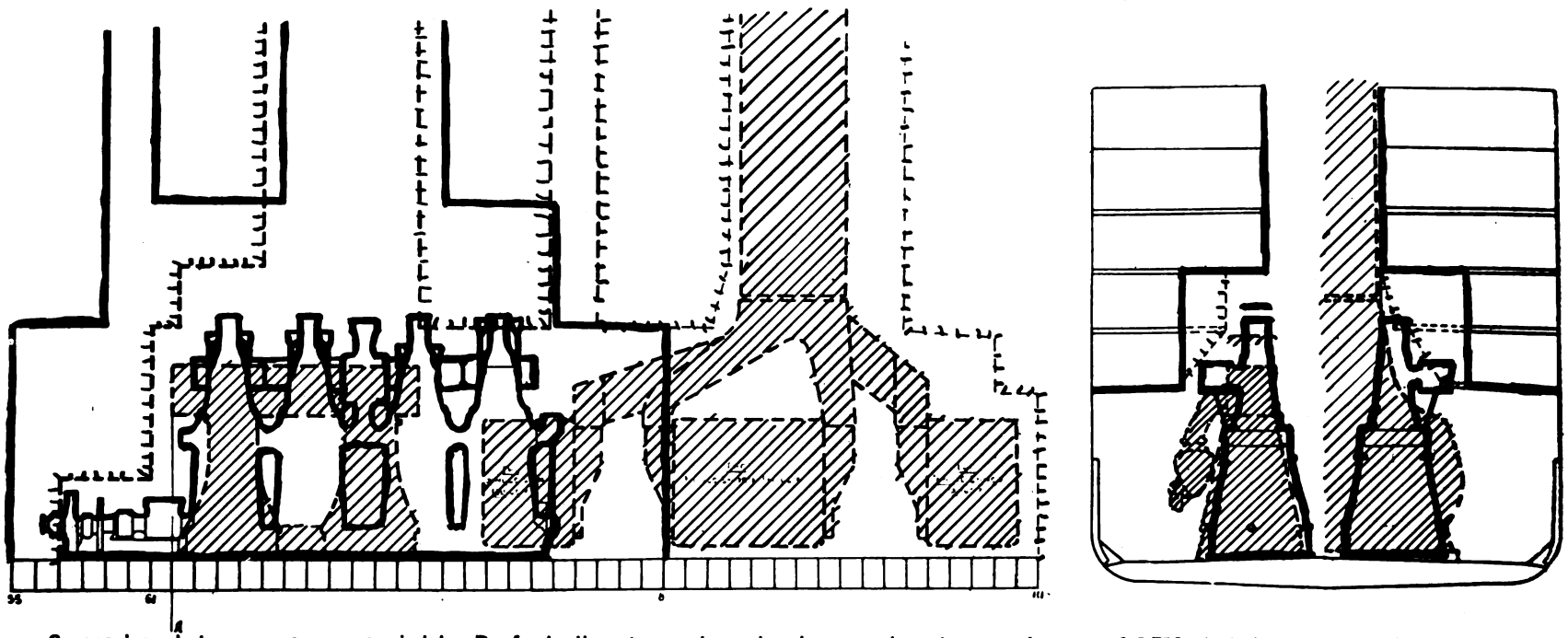
Here again is a departure from the usual designs, in which only single pairs of columns are placed over the main-bearings. Because of this arrangement, if any stresses come through the columns at all, they could at the worst produce only transverse deflections in the bed-plate, a consideration of prime importance from the point of view of crankshaft alignment. Even in this matter the designers of the Doxford engines have taken no chances; they have made the shells of the main-bearings spherical and self-aligning. In other words, Doxford journal-bearings can be made self-aligning because the shaft-journals transmit nothing but pure torque and are not subject to appreciable lateral bending.

Surmounting each group of four columns is a deep entablature in which several functions are neatly combined. Since it is cast hollow, it can serve as the scavenging-air duct; it is bored to receive the lower end of the cylinder and provides for remarkably free flow of scavenging-air to the circumferential cylinder-ports. It contains the crossheads for the upper piston and forms a rigid bridge on which is carried the standard for supporting the upper cylinder structure.

The fuel-pumps have unpacked plungers and their delivery is controlled by an Aspinall governor, or by hand-regulation of the suction-valves. In order to be able to cut-out a leaky pump and at the same time to secure the benefits of a common discharge and equalized fuel-pressure on all the cylinders, the delivery-tubes from all eight pumps are brought together in a steel distributor-block located near the control position. Screw-plug valves in these permit of ready switching from individual pump deliveries for individual working-cylinders to a common delivery for all cylinders. A spare fuel-pump, independently steam or motor-driven, can be cut-in at short notice if the need arises.

There are two camshafts on the engine, one on the front and one on the back, and each is independently driven through spiral gears from the crankshaft. The reason for this is that there are two fuel-valves in each cylinder, as in the original large Junkers engines previously referred to. The front camshaft drives a single starting-valve in each cylinder and the rear shaft also drives indicator-gears and cylinder lubricators. Only the front camshaft is reversible and the rear fuel-valves are not operated during astern running.

Other radical departures from accustomed Diesel practice which are reported as highly successful, are the use of steel-capped partially-cooled pistons, low compression (300 lbs. per sq. in.) steam-heating of the jackets during starting, and the solid-injection of fuel at a pressure of 10,000 lbs. per sq. in. It need hardly be pointed out that all these features are inter-related. The purpose of the high metal-temperatures of the combustion-space is to offset the handicaps due to solid injection and low compression and its accomplishment is attested by the clean consumption of Mexican residual-oil having a heating-value of 17,600 B. T. U. and an



Comparison between spaces occupied by Doxford oil-engine and quadruple-expansion steam-engine set of 3,750 shaft h. p. and of similar speed. Cylinder of steam-engines are 26½ in. by 37 in. by 53 in. by 74 in. by 54 in. stroke at 85 R. P. M. Overall length of steam machinery 114 ft. 4 in. Overall length of Diesel machinery 50 ft. 6 in.

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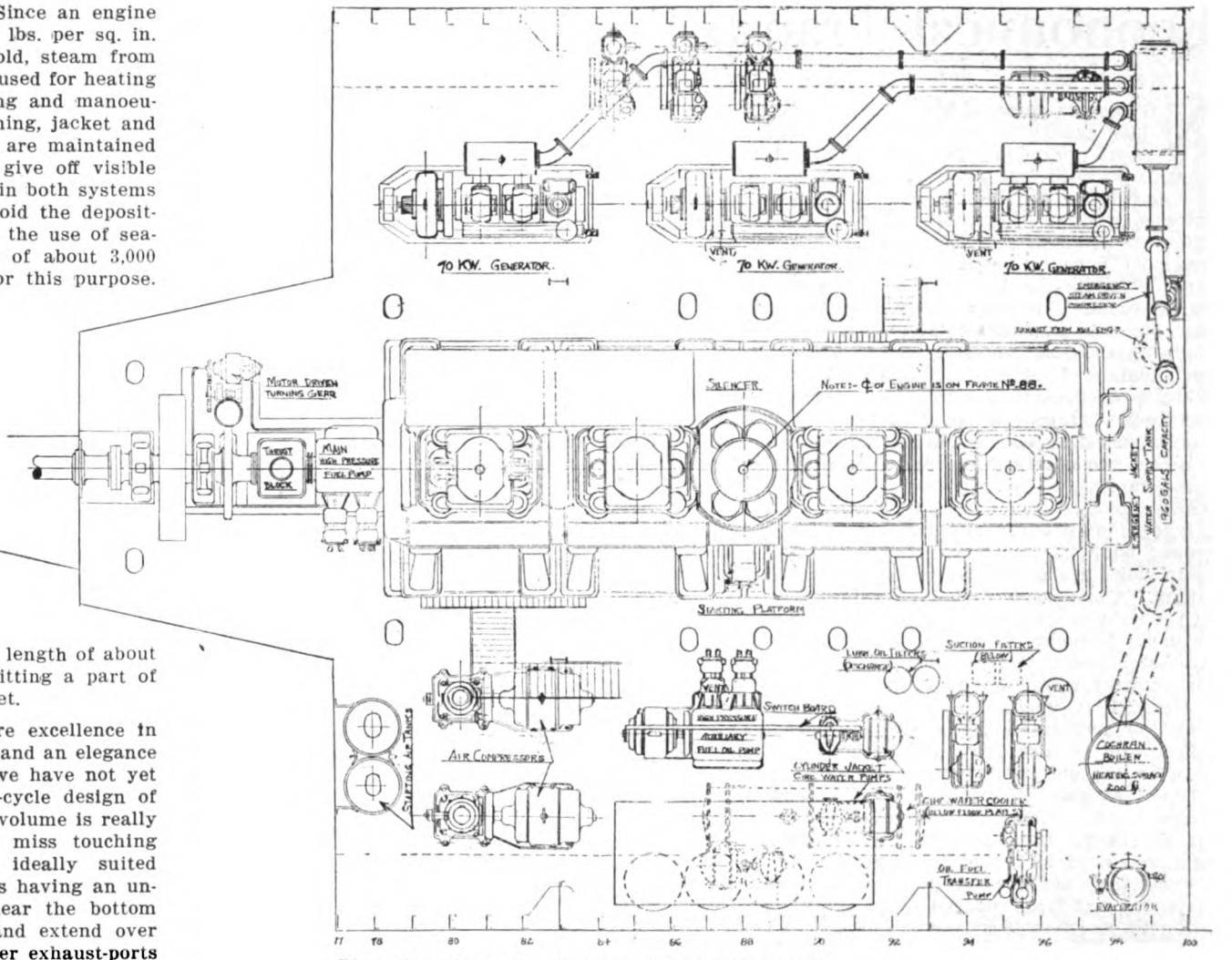
asphalt content of 22 per cent. Since an engine having a compression of only 300 lbs. per sq. in. would naturally not start from cold, steam from the small oil-fired donkey-boiler is used for heating the cylinder-jackets during starting and manoeuvring. Even during ordinary running, jacket and piston-cooling water temperatures are maintained at a point where the discharges give off visible vapor, and the use of fresh-water in both systems becomes necessary in order to avoid the depositing of salt that would accompany the use of sea-water. This means the carrying of about 3,000 gallons of fresh-water in tanks for this purpose.

In order to eliminate the well-known heat distress ordinarily resulting from the use of high jacket-water temperatures, cylinder liners having a wall-thickness of only one-inch are used, and they are provided with the necessary strength by means of ribbing, a feature which also increases the rate at which the desired heat-transmission is effected. The tops of the ribs, according to our understanding, are machined cylindrical and permit the liner of being made a tight fit in the water-jacket over a length of about three feet and of thereby transmitting a part of the hoop-stress to the outer jacket.

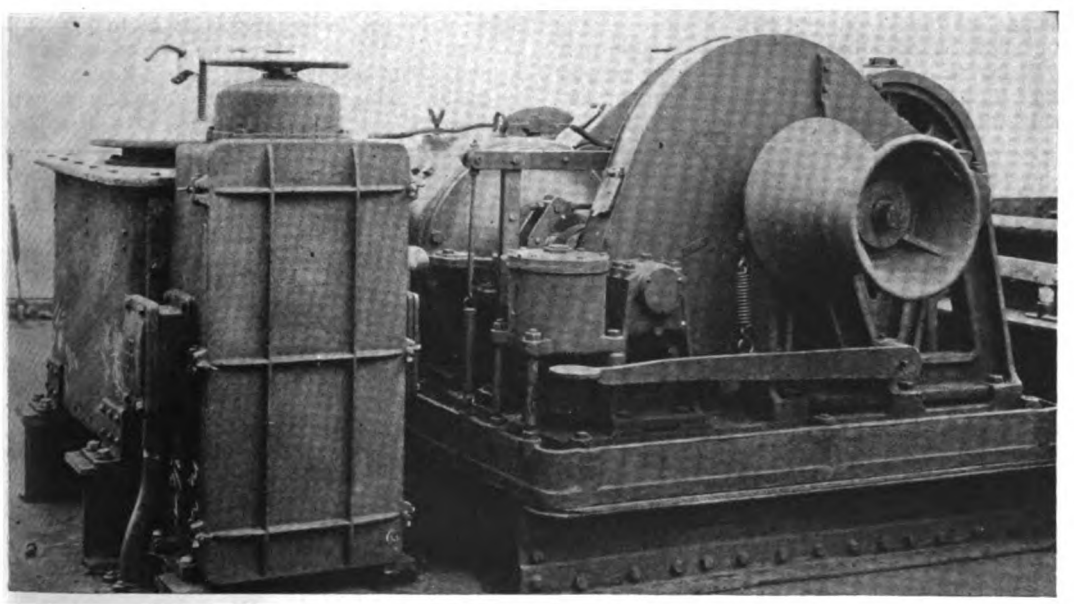
Inherent in the construction are excellence in the shape of the combustion-space and an elegance of the scavenging process which we have not yet seen exhibited by any other two-cycle design of "Diesel" engine. The combustion volume is really the space by which the pistons miss touching each other, and has a shape ideally suited to the burning of fuel. Inlet-ports having an unusually generous area are cut near the bottom dead-center of the lower piston and extend over 360 degrees, while somewhat higher exhaust-ports are similarly located near the top. Towards the end of the pistons' outward travel, the earlier opening of the exhaust-ports permits the pressure in the cylinder to blow down, whereupon admission of scavenging-air through the inlet openings commences. Owing to the fact that entrance of air is completely circumferential and that it can travel the length of the cylinder, practically as a solid column without having to double back on itself, a rare degree of perfection in the scavenging process is attained. It amounts, in effect, to uniflow scavenging.

The practical consequences of this are that a very complete substitution of fresh-air for burnt-gases is made, that low-grade fuel can be consumed with a high degree of cleanliness and perfection, low scavenging-air pressure can be employed, power-consumption of the scavenging-pump reduced and certain operation even with greatly diminished scavenging pressure is made possible at remarkably low revolutions per minute. Absolutely steady running at 17 R.P.M. is claimed for this Doxford engine whose normal designed speed is 77 R.P.M. We have personally witnessed the single-cylinder experimental engine running at 20 R.P.M. on load burning heavy Mexican residue. Such flexibility is unattainable to-day in a six-cylinder four-cycle engine because it has too few power impulses per revolution, although, of course, the average reputable four-cycle engine has ample flexibility to cover all regular manoeuvering of a ship. In two-cycle engines as ordinarily built, a reduction in speed causes so sharp a falling-off in scavenging efficiency, unless the scavenging-pumps are separately driven, that poor cylinder filling and unsteady firing manifest themselves considerably earlier than seems to be the case with the Doxford engine.

The bore of this machine is 22.84 inches and the stroke of each piston by itself is 45.66 inches. Although the piston-speed is only 586 ft. per min., the pistons actually approach and recede from one another with a mean velocity of twice that amount, namely 1,172 ft. per min. and their total stroke is *seven feet* and 7 1/32 inches. A full-grown man with a child sitting on his shoulders could stand erect on the lower piston while the latter was on the outer dead-center without letting the child's head touch the upper piston, as the addition of the clearance space brings the extreme distance between pistons to more than eight feet. Finally, at the risk of making an anti-climax, we call attention to the fact that the development of 650 brake-horsepower in a "commercially-applied" engine-cylinder is a record which will probably remain unexceeded for a while, although the new Ansaldo San Giorgio Diesel-engine develops the same power per cylinder at normal load and at 100 R.P.M. We understand that three additional Doxford engines of this power in their own plant and two more are about to be built by a licensee. Doxford licensees in Europe are the Fairfield Shipbuilding & Engineering Co. of Govan, Glasgow, and the Motala Verkstad of Motala, Sweden (A/B Lindholmen-Motala, Göteborg.)



Plan of engine-room of the motorship "Yngaren"



One of the cargo-winches on the Doxford-built motorship "Yngaren"

TURBINE-ELECTRIC DRIVEN SHIP "ECLIPSE"

In our next issue we shall have some further comments to make regarding the 12 vessels which the Shipping Board is changing to turbine-electric drive, because the result of the "Eclipse" in service with her new machinery makes it obvious that further work on conversions should be suspended and the installation changed to Diesel-electric drive or direct Diesel, the "Eclipse" showing an even higher consumption than with her original geared-turbine. We have before us figures regarding her first voyage; namely, from New York to Batavia and back.

Shaft h.p. fuel consumptions were taken only for 10 stages of this round voyage, aggregating 23,611 nautical-miles, which was covered at an average speed of 9.68 knots. This consumption figured out at 1.28 lbs. per shaft h.p. hour, or slightly over three times the fuel-consumption of the Shipping Board's Diesel motorship "William Penn."

Had not the boilers been fitted with superheat, the "Eclipse's" fuel-consumption would have shown a 20% increase over the geared-turbine drive, whereas the increase is actually 10%. Other figures will be given next month.

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Economical Transportation on the New York State Canal

A Series of Exhaustive Articles on Barge Commerce Along the World's Greatest Inland Waterway

PART IV.

Types of Canal Craft

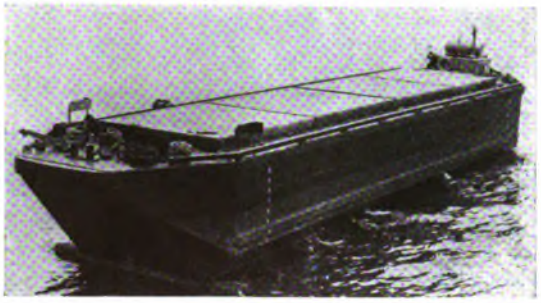
NO one has operated boats on the new Canal long enough to be able to say, "This is the most profitable type of vessel that can be used!" Cargoes just as diverse as those which are carried on the high seas are available for shipment, and problems of handling and transshipment equal in complexity to those of ocean transport have to be met in working-out good types of boats for use on the New York State Barge Canal. Conditions of navigation are simpler, but it is a mistake to assume that operating boats on the new waterway between New York and Buffalo is "like sailing in a bathtub." Weighty as these still-to-be-solved problems are, our study of transportation along the Barge Canal has convinced us that the Canal's future is assured and that the excellent prospects already in view make inevitable the necessary development of means and methods of navigation.

Indeed, the opportunities for "getting in on the ground floor" of this new development are such as to make it a highly attractive business undertaking. The very fact that conditions have not as yet become stabilized and that experience and business footholds have not been cornered by long-established concerns leaves open the way for enterprise and determination.

Although it would obviously be wrong to attempt to operate on the newly-completed Barge Canal with the same boats and methods that were used on the old Erie Canal, it would also be a mistake entirely to ignore the experience with which epoch-making results were achieved on the old waterway. Little need be said of man-poling that was used in the early forties, or of mule-towage that persisted until the spacious new waterway and large modern boats put an end to it during the first decade of the present century. There was, however, a good deal of steam towing of fleets of barges from about 1870 on, and self-propelled steam-barges came into use to some extent a little later on. It is the experience on power-towed and automotive craft that is of interest from the point of view of the modern Canal.

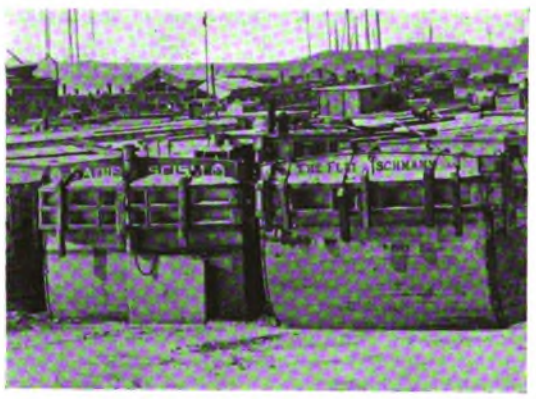
In applying the knowledge gained on the old canal to the new one, it should be remembered that the two waterways differ not only as to size, but also in the fact that the old Erie was a real canal, cut in dry earth and rock along a route that everywhere avoided contact with lakes and natural streams, whereas the New York State Barge Canal consists for more than two-thirds its length of "canalized" rivers and lakes. Stupendous engineering works have been built which make the new Canal absolutely safe to navigate, but this does not alter the fact that during some seasons of the year strong currents (5 to 6 knots) are encountered in certain regions, notably in the Mohawk River, and that appreciable storms must be weathered by boats passing through fairly large lakes such as Oneida and Onondaga.

Towing a fleet of passive barges by means of a regular steam tugboat was the most up-to-date method in vogue on the old Erie Canal. It did not, however, mark an entirely complete advance over mule towage, since no attempt was made to speed up the barges. In fact, practically all of the barges were of the 240-ton "Erie Canal" type, which permitted comfortable towing by mules



Transmarine Line 400-tons barge to be used for linking-up Great Lakes and Ocean Commerce under the organization plan of the Great Lakes, Hudson & Atlantic Waterways Association

and entirely satisfactory manoeuvring at a speed not greatly exceeding 3 miles per hour. Since all these boats had squarely-chopped-off sterns, which greatly interfered with the free flow of water around their rudders, any attempt to speed them up made them quite unmanageable. The application of steam towing to barge transportation did not therefore do much to increase the speed of the boats, because their sterns would have had to be rebuilt in order to make this possible.



Bow and stern views of antiquated canal craft showing ineffectiveness of rudder

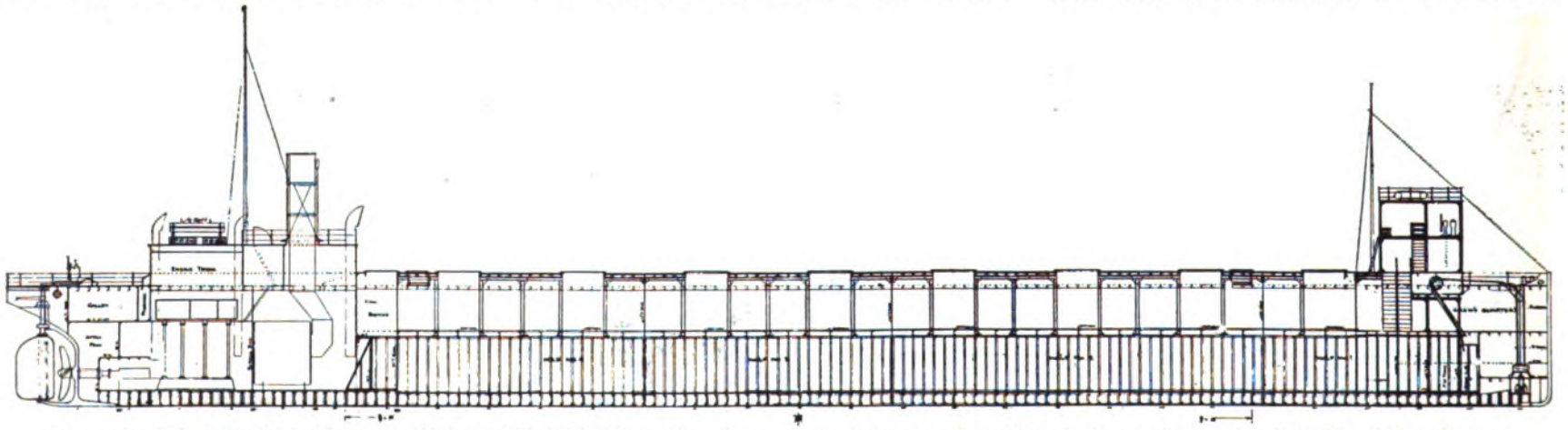
Certainly the need for such a drastic step did not even occur to many Canal men at that time, and it is beginning to be acknowledged only slowly at present.

Response to the helm is nevertheless a very important matter in canal craft, because of the rather sharp bends that are found in the new as well as in the old canals. Steering a tow through tight places is no child's play under any circumstances, a fact which led to the employment of special devices for directing a string or "sausage" of barges. The most successful of these, which, by the way, is being employed by the Transmarine Corporation on their 400-ton modern steel barges, consists of a triple lashing between bows and sterns of successive barges, disposed to permit of slacking off and tightening the outside ropes by means of a special hand windlass in such a way as to point the ahead barge either to port or starboard. A log fender hung between the ends of the boats forms a fulcrum against which they are hauled together firmly enough by the centre lashing always to maintain contact, and just slack enough to permit them to pivot, according to the complementary playing-out and hauling-in of the outside ropes.

Naturally boats handled in this manner do not require great rudder responsiveness; on the other hand, the men in charge of them must know what they are doing far more than is required of ordinary helmsmen. By no means all of the existing canal barges are equipped with this type of steering device and its adaptability under the new conditions, is one of the problems which will require solution. In any case, barge architects will play safe by giving the sterns of their craft sufficient fineness to insure free flow of water around the rudder at all speeds.

Whatever may be the difficulties that are presented by the steering of tows, there can be no doubt of the advantages of the towed passive barge in certain other respects. Especially for hauling bulk cargoes of a low class, for which barges must necessarily wait both to load and unload, the absence of interest and depreciation charges for power-plants in each barge is of importance, and it is usually possible to arrange for practically continuous employment of the power plant in the tug. The machinery crew of the tug also serves for all the barges, whereas self-propelled barges must each have an engine-crew of its own. Different conditions of navigation can also be readily met by simply changing tugs. For example, tows of barges coming through New York Harbor and up the Hudson might need a powerful and expensive tug as far as the locks at Troy; after locking through a smaller tug could take them through Lake Oneida as far as Syracuse. Since there is "bathtub sailing" practically all the way from there west as far as Tonawanda through the "land line" in the neighborhood of Rochester, a still smaller towboat would be employed. This, of course, implies considerable organization and regularity, and will undoubtedly be made much of in the near future.

The expedient of taking a passive barge and putting enough power aboard it to propel itself and at the same time tow a fleet of passive barges has some advantages, but there were only about twenty-four of this type on the old canal, and the ones that have been put on the new canal have not had a proper try-out. The older type is built of wood, and, with the exception of the stern, was modeled closely after the 240-ton type of Erie canal-boat. Like the latter, it was 96 ft. in length, had a beam of 17½ ft. and drew 7 ft. of water when loaded. The steam-engine which it carried was 14 in. by 16 in., ran condensing, swung a 5 ft. by 6 ft. wheel at 135 r.p.m., and gave the boat a



"Sea-going Canal Boat" built by the McDougall-Duluth Shipyards. Same general type as five oil-engined vessels furnished to Mr. Julius Barnes of the Erie Canal Transportation Co. for carrying grain. The steam plant shown was changed to Skandia surface-ignition oil-engines

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speed of from 8 to 9 mi. per hr. light. Carrying a load of 150 tons and towing three loaded 240-ton Erie canal-boats, the combination is said to make only 3 mi. per hr. A curious feature was the use of rigid arms to connect with the passive barges, which were shoved ahead instead of being pulled from astern in the usual manner. All the steering had to be done by the steam barge, and it is difficult to see how bends in the canal were negotiated. That such a combination could weather a storm on Lake Oneida or buck the current of the Mohawk River during a spring freshet, hardly seems probable.

A somewhat similar arrangement was put on the new canal by the Division of Inland Waterways of the United States Railroad Administration, and subsequently operated by the Inland and Coastwise Service of the United States War Department. The passive steel barges are 150 ft. in length, have a beam of 20 ft., and a depth of 12 ft.; their deadweight capacity is 560 short tons on a draft of 9 ft. From these were evolved the self-propelled barges by the simple process of fairing-up the stern a little and installing two 200-h.p. steam-engines with a boiler, fuel and water tanks, extra crew's quarters, etc. The molded dimensions are exactly the same as those of the passive barges, but the deadweight capacity is reduced to 390 short tons.

The method of operating these craft was to use one loaded steam barge for towing three loaded passive barges. As the dimensions of the combination were slightly more than 300 by 40 feet, it could be accommodated as a unit in the new 310 by 45 ft. locks.

Owing to the disturbed conditions under which these government boats were operated, anything like a real judgment as to their merits is out of the question. As a tentative estimate, however, it appears justified to state that they did not have sufficient fineness of stern to permit of safe manoeuvring at the speeds which their large power gave them. The fitting of twin rudders to the steam barges was resorted to and yielded some improvement.

Little can be said in defense of installing steam on these vessels, particularly since a well-known and successful firm of oil-engine builders offered to place on the dock alongside the boats oil-engines excellently suited for the service without charge except if the government decided to keep them after a four months' trial. Oil-burning water-tube boilers supplied steam at 200 pounds per square-inch pressure, and should consumed oil-fuel at the rate of 600 pounds per hour. But, the last-named figure has been supplied by ourselves, because those given on page 40 of the Report of Inland and Coastwise Waterways Service of the U. S. War Department indicate an abnormal fuel-consumption—the report definitely stating 1,150 gallons per hour, or more than is used by the biggest ocean-going Diesel ship afloat. Presuming the "gallons" is a misprint and that "pounds" is meant the consumption is still enormous. On the other hand, we have been advised that some of the stern-wheel tugs on the Mississippi River burn as much as 7 pounds of coal per b.h.p. hour. As the capacity of the fuel-tank of the New York State Canal craft is given as 45.5 tons, we estimate that the cruising radius of the steam-barge is limited to six days, barely sufficient for a return trip between New York and Buffalo. Had oil-engines been installed, three such trips could be made on a single bunkering of fuel.

An oil-engine installation would also have permitted placing the forward engine and boiler-room bulkhead 10 feet further aft, and would have increased the cargo space and earning capacity by 13 per cent. One member of the crew at least could have been dispensed with at a clear saving per season of $600.

In due fairness to the War Department it should be made perfectly clear that these craft were not designed and built under its supervision, but were planned by the U. S. Railroad Administration's Inland Waterway & Coastwise Service. The War Department has demonstrated that it is strongly in favor of internal-combustion power for propelling vessels, and during and since the war built a total of 38 craft with Diesel and other types of motors for other services.

A fleet of these steam-barges have just been sold by the Government, and as they can be of little profit to anybody in their present condition, we hope that the purchase-price was a sufficiently low figure to permit altering them for economical oil-engine power in the manner suggested at a very reasonable ovar-all cost. No expense was spared in building them; they are rugged and substantial, and should make a first-class set of boats after they are reconditioned. They would furnish excellent means for building-up Canal traffic.

Self-propelled cargo-carrying units have the important advantage of not requiring the organization and maintenance of a towing service, and at the same time they permit of towing passive craft should it become desirable at any time to do so. For an immediate entrance into the Canal transportation business without the delays incident to the establishment of dependable and regular tugboat service self-propelled barges are very much to be commended. State towing has been abolished and our study of conditions does not indicate to us that private individuals will be quick to respond to the demand.

It will be a puzzle to us, however, if the possibilities of oil-engine tug-boats will not be recognized in the near future. To the advantages of separate towing which we have pointed out can be added many others if oil-engine propulsion is used. The elemination of such heavy stand-by losses as those to which steam-craft operating through the many locks of the Canal are subject is a matter of great economic significance. Internal-combustion engined tugs can also easily accommodate all the power that is needed within a length that avoids the heavy hand of the Steamboat Inspection Service and the classifications as to personnel imposed by labor unions. "Two-man" tug boats are brought within the reach of useful and economical application by the use of oil-engine power.

Good results with sixteen Diesel-engine tugboats on inland waterways in France were reported in a recent issue. Two types are mentioned as having identical hull structures, but powered respectively with Polar and Sulzer Diesel engines. Hull dimensions are as follows:

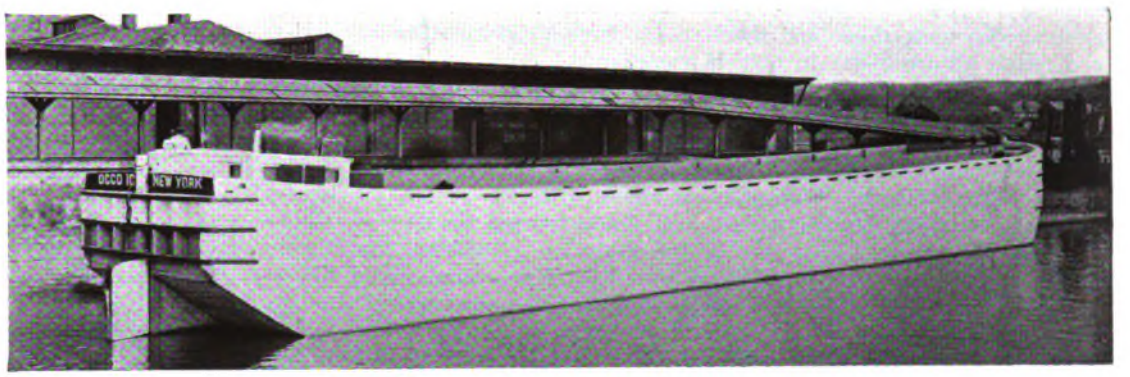
Length B. P.	85 ft.
Length O. A.	92 ft.
Beam	16 ft.
Draft	9 ft. 6 in.
Displacement	145 tons
Power	350 and 420 b.h.p.

Both kinds of motors are of the four-cylinder two-cycle type running at 200 r.p.m.; the Polar machine develops 350 b.h.p. and the Sulzer 420. The auxiliaries consist of a combination air-compressor and dynamo built-in with a 12 b.h.p. Polar oil-engine, which is also belted to a small bilge and ballast pump. Living quarters are provided forward for the captain and engineer, and aft for an oiler, deck-hand and cook. The weight of the main engine and auxiliary machinery is 40 tons. Sixteen of these craft have been built or are on order for the French Government for use on the river Seine, and all the trial runs which have been made thus far have been highly satisfactory. These vessels were described and illustrated in "Motorship" of August, 1920.

The New York Canal System is better supplied with passive barges than it is with the tugboats to tow them. Although steel barges are coming into use, it is not established that they will replace wooden ones. There is no doubt that the employment of steel for craft less than 120 ft. in length is at a disadvantage in comparison with wooden construction, and the range of usefulness of wood unquestionably extends up to lengths as great as 175 ft. A design of barge which retains all the homespun goodness of the wooden canal boat and which at the same time takes into account modern operating conditions is the "Occo" type of the Ore Carrying Corporation. Four 1,000-ton barges like this have been built and are in service; they have a length of 152 ft., beam 25 ft., depth 15 ft., and can carry 800 tons deadweight.

Sixteen 400-ton steel barges of up-to-date design will be operated during the present season by the Transmarine Line. They, too, have considerably more fairness than the Erie canal boat, and should be responsive to the helm at the speeds at which they are likely to be used. The designers have played safe, however, in providing the double-hand steering-winches already described.

A new type of Canal craft, which can be classed neither as self-propelled barge, or as tug, is the so-called "sea-going canal boat." Since these vessels are fully capable of handling themselves, and can develop a speed of something like 8 knots in open water, the reason why the name barge does not exactly fit them is apparent. They also differ essentially from the self-propelled barge in that they are not adapted for towing. Against a possible criticism that if these boats are built to stand open water service, they are incurring unnecessary overhead while passing through the canals, must be weighed the fact that the modern Canal permits a speed of 6 miles per hour. Moreover, the vessels can carry cargoes from Duluth to Delaware Bay with a speed to which that of no other actual transportation method can compare.



"Occo" type of modern wooden barge suitable for economical towing by up-to-date oil-engined tugs

Credit for originating this type of craft belongs to Mr. Alexander McDougall of Duluth, whose foresight in choosing oil-engine propulsion for the first of them actually to be placed on the Canal is also to be commended. We have at our disposal cuts only of Mr. McDougall's steam-driven sea-going canal boats, but they show in a general way how the new oil-engined vessels will look, the first of which is en route to New York with a big cargo of grain. Their most distinguishing characteristics are their strong resemblance to lake freighters, their generous utilization of the dimensions afforded by the modern locks, and their removable superstructures.

Five of these sea-going canal boats will soon be operated by Mr. Julius Barnes of the Erie Canal Transportation Company (Interwaterways Line Inc.). They are 250 ft. in length, have a beam and depth of 36 and 14 ft. respectively, displace 2,150 tons at 10 ft. draft, and carry 1,500 tons. Each one will be driven by two 140 b.h.p. Skandia surface-ignition oil-engines. Cargo-handling and steering equipment is electric and of the most modern design, having been furnished by the American Engineering Company of Philadelphia. Nothing has been spared to put these boats on a par with the most highly developed ocean freight-carriers now known.

It need hardly be added in conclusion that this brief review of some of the progress which has been made in devising efficient Canal craft, corroborates the view that Canal transportation is on the threshold of a new era, in which the application of economical oil-engine propulsion is destined to play a brilliant part.

JULIUS KUTTNER, Special Commissioner.

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MOTORSHIP

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ACTIVE MOTORSHIP CONSTRUCTION ON THE PACIFIC

A motorship construction revival is just starting on the Pacific Coast. In the past shipowners on the Pacific Coast of the United States have paid more attention to visiting foreign motorships than have shipowners in the East, probably because several important motorship lines have been established between Pacific ports and Europe, and these foreign Diesel-vessels have lately been carrying American products while our own steamers have been tied-up. About eighty motorships were built on the Pacific Coast during the war, of which many were underpowered wooden auxiliaries and unsuitable for post-war commerce competition. Over a dozen were full-powered wooden motorships, and these vessels have all given splendid service and nearly all are to-day in regular operation.

Recently Pacific Coast shipowners turned their attention to full-powered steel motorships and the first big vessel of this class—the 6,500 tons 2,200 i.h.p. Diesel-freighter "Kennecott" has been in most successful service for several months. Her performance, also the splendid service of the Diesel-tanker "Charlie Watson," combined with knowledge previously gained by studying foreign vessels, have converted practically every shipowner in the West. Those who several years ago considered the Diesel-driven ship a very hazardous proposition have now veered round like a changing wind, and to-day are numbered among the most powerful advocates. It may be said with accuracy the situation on the West coast to-day is that all shipowners, operators, designers and builders have all come to the conclusion of the superiority and practicability of the ocean-going motor-vessel.

Consequently, the "Kennecott" is to be immediately followed by a number of new motorships. The Puget Sound Towboat Co. are having a new Diesel freighter of similar power, while the Puget Sound Navigation Company are having a 2,000 h.p. motor ferry-vessel to carry 2,000 passengers and 60 automobiles from Seattle to Bremerton, and will convert their existing steamers to Diesel or Diesel-electric power. The Alaska Steamship Co.—it is reported—will follow the same procedure and convert their steamers commencing with the "Alameda." Also, the Carey Davis Tug Boat Co. are to convert their nine steam-tugs to Diesel-motor power, and work on three will be commenced this Fall; while the Dollar Steamship Co., of San Francisco, are figuring converting seven steel German hulls to motor power. Then again the Hibbard-Swenson Company are to have a motor-auxiliary built to replace the "Kamchatka" lost by fire last season. Thus three new motorships and many conversions are on the immediate constructional programme and soon may be followed by others which makes the Pacific Coast a bright market in these dull times for engine-builders, and equipment manufacturers. Also, it probably will stir Atlantic Coast shipowners into quick action converting their steamers into motor power.

Our August issue will be a Special Pacific Coast Number, and complete stories dealing with all these new orders will be given. Support this motorship movement, by advertising in this feature number.

COST OF DIESEL VERSUS STEAM ENGINES

Conversations with a number of American shipowners have revealed that some of them are convinced in their own minds that it would not pay to operate motorships on short routes, and that taken all-round steamers are better in cases where voyages do not exceed several days in length. They argue that because no large quantity of fuel need be carried, the gain in cargo space made by the motorship due to her lower consumption and saving in machinery weights is not sufficient to cover the bigger interest on capital-cost, greater depreciation, insurance, etc. And, that for sufficient economies to be shown to warrant adoption for vessels running on such routes as New York to Cuba the first-cost of motorships must be brought nearer to that of steamers, instead of remaining about 10% higher.

While we cannot coincide ourselves with this finding, we believe the adoption of the Diesel-engine will be substantially assisted if the cost of this type of machinery can be reduced to a figure nearer steam-engine, boilers, and condensers. Ordering Diesel-engines in considerable numbers and so allowing thorough standardization and quantity production will do much in assisting to bring this about. Up till now our oil-engine builders have been badly handicapped by being awarded with orders for only one or two engines at a time. Shipowners' attentions, too, should be drawn to the possibility of making a motorship from 5% to 12% smaller overall in accordance with the voyage-distances, and in this manner lower the cost of the hull, shafting, propellers and power, also cost of the engines, to an equivalent percentage. This can be done and the vessel will still lift the same amount of net-cargo as the larger steamer. In this manner the first cost of a motorship can be reduced to at least that of a steamer.

STEAMSHIPS AND THEIR FUEL-BILLS

Things exactly as they are, and when given in their most concise form, often carry their greatest lesson without comment. A case in point: Last year the income of the Cunard Line was $15,000,000 over the previous year, but which was more than counterbalanced by increased costs, of which the a motorship can be reduced to at least that of a steamer.

A well-known American firm of steamship owners on the Pacific Coast, who have just decided to build a large motorship and to convert their present fleet of steamers to Diesel power, were partly influenced by the fact of their oil-fuel bill having suddenly been increased by $1,000 per day. This also applies to another Pacific coast steamship company who recently took delivery of their first ocean-going Diesel freighter. The difference in the fuel-bills is so great that they have decided to convert one of their oil-fired steamers to oil-motor power. Both vessels are burning the same grade of fuel, the steamer using 300% more than the motorship, which is a tremendous difference. The head of one of these two steamship companies recently advised a representative of "Motorship" that he wouldn't take all the steamships in the United States as a gift, because they simply cannot be run successfully in competition with motor-vessels.

TANKER SELLS BUNKERS AS CARGO

The remarkable economy of her Diesel-engines enabled the new motor-tanker "Seminole" to discharge 200 tons of her bunker-oil at Avonmouth after crossing the Atlantic from New York and she still had sufficient oil for the next passage to Baton Rouge, La. She is a vessel of 10,050 tons d.w.c. and when she left New York she had on board 9,123 tons of oil-cargo and 672 tons of bunkers in addition to a large number of cases of oil-stoves. Altho she averaged 11.4 knots, her total engine fuel-consumption across the Atlantic was only 138 tons. This is a result impossible for any steam-driven tanker to attain.

CONVERT THEM TO ECONOMICAL DIESEL POWER

A fleet of five steamships have been laid-up for several months by the Garland Steamship Company, 511 5th Avenue, New York—says W. M. Campion, the Vice-President and General Manager—because the rates then, as well as now, did not produce a gross income sufficient to meet the *actual operating costs,* not including interest or depreciation, and the owners can see no hope for resuming operation until a remedy is found. This state of affairs is exactly what "Motorship" accurately forecasted. We have also indicated the remedy, namely convert the ships to economical Diesel power, and thus reduce the operating costs and increase their cargo-capacity. We suggest that some enterprising Diesel-engine builder work out the conversional costs with the Garland Co. and submit a bid in conjunction with some dry-dock company.

FUEL IS GREATEST EXPENSE OF SHIP OPERATION

The cost of fuel in American merchant vessels is about 43% of the total operating expense, says Mr. G. W. Yarus, Chief-Fuel Inspector of the United States Shipping Board, N. Y. We will add that steamships use 300% more fuel than do motorships, so an enormous saving can be effected by conversions to Diesel power.

THE DAY OF THE HIGH-POWERED MOTORSHIP

It would appear that the day of the high-powered motorship is much nearer than steam interests would have shipowners believe. Some time ago we referred to some German engines of 12,000 to 16,000 shaft horse-power having been completed for battleship purposes. Now several leading shipbuilders are at work on Diesel units of high-power for merchant ships. It is known that Burmeister & Wain are at work on four engines of 4,000 i.h.p. for an 18-knot Swedish passenger motor-liner, but it is not so generally known that Harland & Wolff have practically completed a pair of 4,000 i.h.p. merchant-marine Diesel-engines. For several months we have had drawings and details of a 4,500 i.h.p. Ansaldo San Giorgio engine that recently ran tests in Italy, while Sulzer Frérés of Switzerland are now prepared to build and guarantee up to 10,000 b.h.p. per shaft. In fact a twin-screw set of 6,000 shaft h.p. is actually under construction in their German factory for a motorship building in a yard in that country; and one of their English licensees is building a single-screw 5,000 shaft h.p. engine. Now comes the news that Cammellaird are constructing a marine Diesel-engine to develop 5,000 shaft h.p. in six opposed-piston cylinders at 90 r.p.m.

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TRANSPORTING WHEAT FROM VANCOUVER TO LONDON

With freight rates at their present level, we doubt if it would pay oil-fired or coal-burning steamers to carry wheat from Vancouver, B. C., to London, England, via the Panama Canal. This, however, was recently done with a substantial profit in the case of the 9,400 tons d.w. Swedish Diesel motorship "Buenos Aires"—altho she made a detour to New York en route in order to "pick-up" her owner. The story of her voyage given in our April issue produced great interest all over the world.

TURBINES AND SUPER-HEATED STEAM

Because of the reduced fuel-consumption thereby obtained, the use of super-heated steam for ship's turbines has been recommended and used in this country. But, a well-known British turbine expert has issued a warning regarding this practice, pointing-out among other things that danger arises from the differential expansion when hot steam is admitted to a reverse turbine. The temperature of the steam suddenly admitted to the idle turbine is generally lower than that in which it has been rotating while idle, which may have risen to 1,000 degress Fahr. or close upon the combustion temperature in a Diesel cylinder. Also that if the same degree of heat were used in marine as in land turbines, impossible conditions would be set-up in the reverse turbine. This is another strong argument in favor of economical Diesel-power as opposed to oil-fired turbines for merchant ships. Superheat was used in the S.S. "Eclipse" to increase the economy.

SEVENTEEN NEW LIGHT SHIPS PLANNED

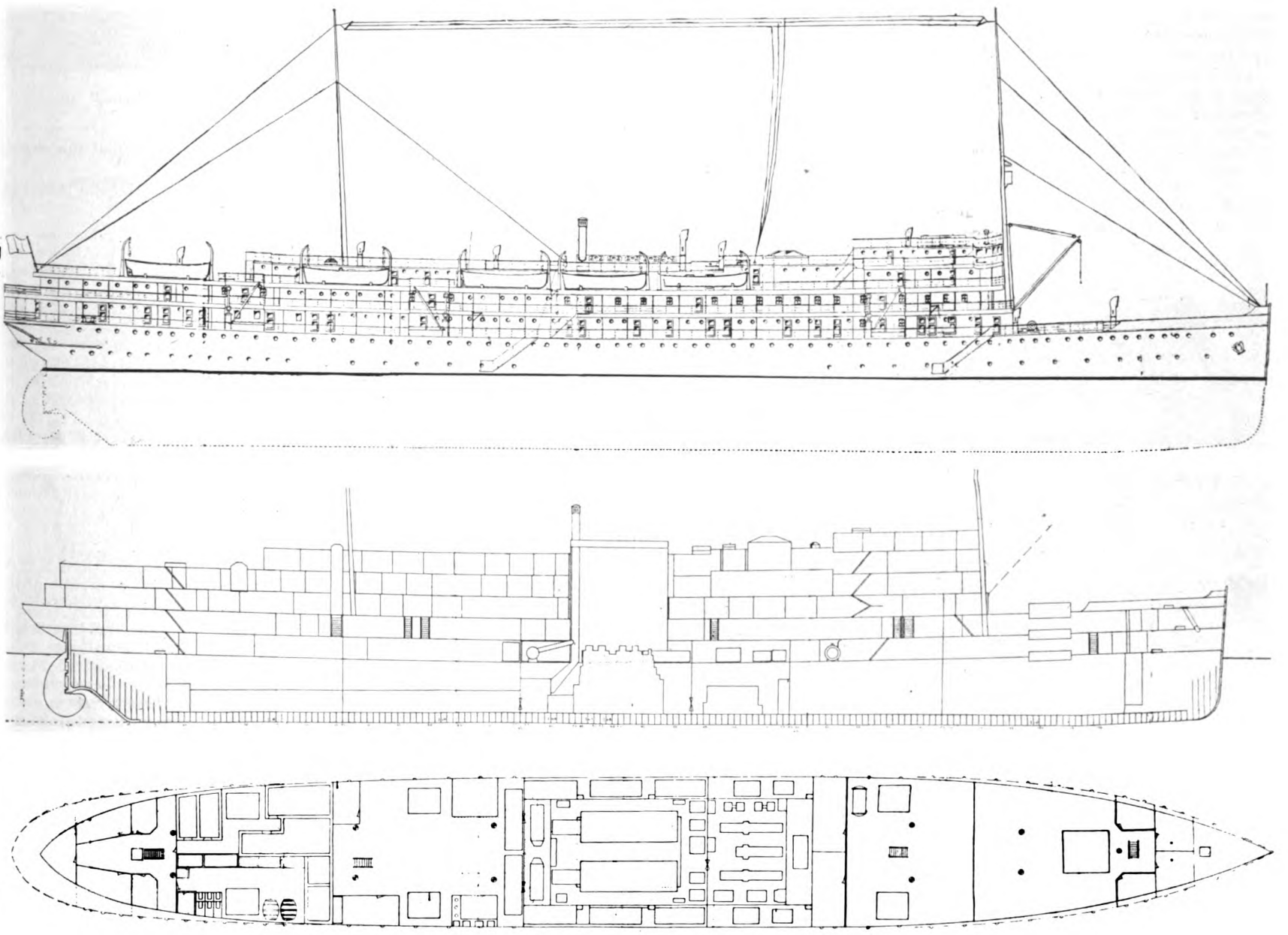
An appropriation of between $4,000,000 and $5,000,000 will be asked from Congress by the Commissioner of Light Houses for the purpose of constructing seventeen light-ships and tenders that are urgently needed by his organization. There are in service in this country a number of light-ships in which the equipment consists of surface-ignition marine oil-engines and we understand these vessels have given very good service. Diesel and other oil-engine manufacturers should do their utmost to induce the Commissioner of Light Houses to build new vessels of the most economical type—that is to say, equip them with heavy oil-engines. Possibly Diesel electric-drive would be very suitable for such craft.

THE RIGHT IDEA

Shortly before the new Shipping Board was announced a prominent shipping man on the Pacific Coast was approached by the press—it having been reported that a position with the Shipping Board would be offered him. He stated that if he was named, he would take all the Shipping Board's wooden ships, and some of the steel steam-ships, have them put into the ocean and sunk. And, if any new vessels were built he would insist upon them being motorships. This is much along our own ideas only instead of scuttling those ships that were not of much use, we would suggest that the Navy use them for target practice.

IMPORTANCE OF ECONOMICAL OPERATION

Recently the big Shipping Board liner "Golden State" left San Francisco for the Orient partly loaded with 4,000 tons of cargo and 19 truck-loads of mail, but the slower Japanese vessel "Shinyo Maru" sailed a few hours earlier fully loaded with cargo and with 3 truck-loads of mail. Had the American vessel been Diesel or Diesel-electric propelled her operating costs would have been sufficiently reduced to have enabled her to have offered a lower rate for cargo than the Japanese ship could have carried it for at a profit. When there is only a limited amount of domestic products to leave this country they should go by American ships, but our vessels must first be changed so that they can offer the lowest rates, and still make a profit. Otherwise they will not get the cargoes.



NEW MOTOR PASSENGER-LINER FOR AMERICAN FIRM

Plans of a passenger and cargo Diesel motor-liner prepared by Ansaldo San Giorgio Ltd. of Spezia, Italy, at the request of an American firm. Construction has not yet commenced, nor are similar motorships building for the Societa Transatlantica Italiana, as recently erroneously reported in other publications. The design shows a vessel of 9,900 tons displacement, 5,800 tons cargo-capacity, accommodation for 350 first and second-class passengers, twin 2,000 shaft h.p. two-cycle Diesel engines, and 13-knots speed. This design is of special interest because of the decision of the Puget Sound Navigation Company to build an 18-knot, 2,000 passenger motorship

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New Diesel Tanker "Seminole" in New York

Here Together With Sister Motorship "Narragansett"

BY a strange coincidence half-a-dozen important American and foreign motorships were in New York harbor at the same time a few weeks ago. Among these vessels were the Vickers Diesel-engined tankers "Seminole" and "Narragansett," both of 10,050 tons d.w.c. and both owned by the Anglo-American Oil Company. The motorship "Seminole" was here on her maiden voyage and is practically a duplicate of the motorship "Narragansett," although she has some minor modifications to her main engines, resulting from the experiences with eleven trips across the Atlantic of her sister, the "Narragansett." Both vessels are built on the Isherwood system.

The "Narragansett" has done splendid work, having averaged 10.2 knots over a distance of 38,465 nautical-miles on a daily consumption of 9¾ tons of fuel for the main engines.

A rather remarkable result was obtained on the maiden round-voyage of the "Seminole" from England to the United States and return, a total time of 31 days having been taken from Barrow-in-Furness, England, to New York, U. S. A., and back to Avonmouth, England, on a total consumption of 299½ tons of fuel-oil for the main engines, the average speed for the round trip being 10.55 knots.

It is very interesting to note that on the return voyage, fully-loaded, her main engines only consumed a total of 138 tons, yet she averaged 11.4 knots. Whereas on the voyage over in ballast she averaged 9.7 knots and consumed 161.5 tons, or 23½ tons more. However, the higher consumption included donkey-boilers for the auxiliaries.

A non-stop sea passage was maintained on the maiden run from Barrow to New York. The 'Seminole" covered 3,115 nautical-miles in 13 days, 10 hours, with unfavorable weather, the engines averaging 2,640 indicated horsepower on 10 tons of fuel per day, so we presume the actual consumption for the main engines only was 30½ tons. The fuel-consumption figured out at 0.348 lb. per i.h.p. hour.

She made a passage back to Avonmouth, England, in 11 days, 11 hours, on a daily consumption of 10.4 tons. The average power developed was 2,873 i.h.p., so that the fuel-consumption was equivalent of 0.339 lb. per i.h.p. We are advised by the owners that everything worked satisfactorily on both runs.

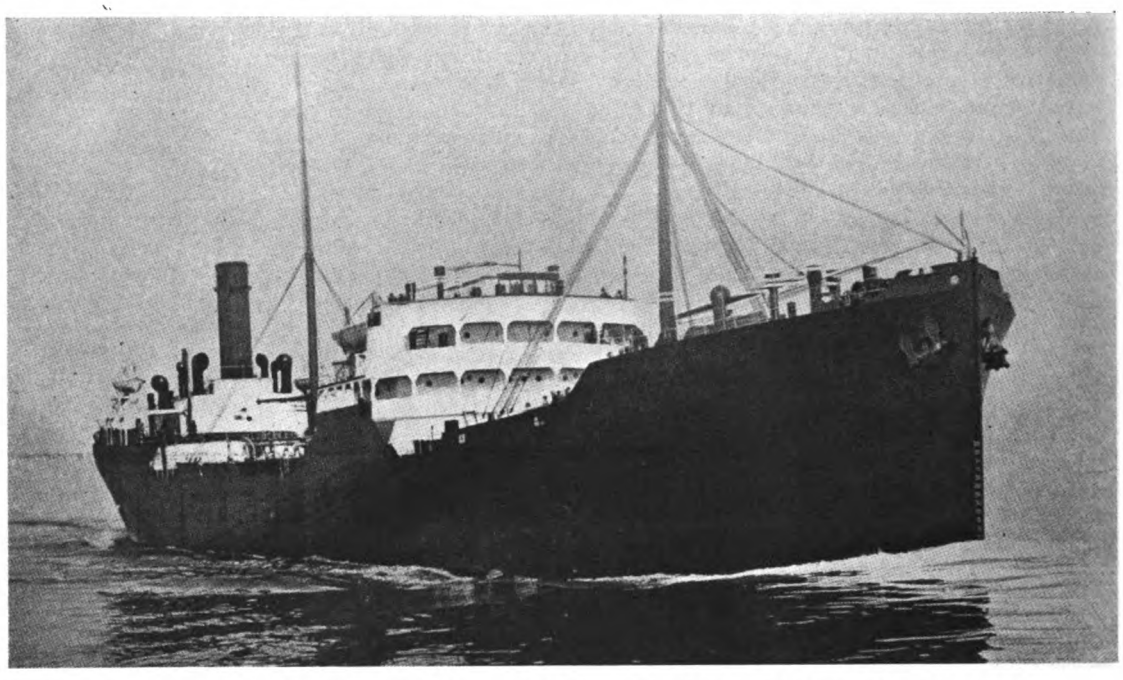
Visitors on the "Seminole" at New York (See following page)

One of the most interesting features of the return trip is that the "Seminole" had on board 9,123 tons of oil-cargo, a large number of cases of oil heating-stoves and 672 tons of bunker-oil. But, she landed 200 tons of her bunker-oil in the form of cargo at Avonmouth, and still had sufficient oil on board to return to Baton Rouge, La.

A large number of visitors went aboard at the invitation of the Anglo-American Oil Company and Messrs. Vickers, Ltd., the builders. Also, Mr. Powell and Mr. Hamilton, directors of the owners, were aboard and made interesting speeches regarding the excellent performances of the two ships. Mr. Bedford also spoke warmly of their performance. Mr. William Huskisson, of Vickers, Ltd., in reply, said among other things:

"For many years the great economy of the internal combustion engine as a means of propulsion has been recognized, but shipowners have hesitated to install it in their ships because of their doubts as to its reliability in working. These doubts had been raised in their minds owing to some of the Diesel-engines in the past having proved failures and having been replaced by steam-engines. Some years ago the late Sir William Preece defined an oil engine as 'A machine that barked like a dog, stank like a cat and was as wayward as a woman.' If this was the view of one of the foremost consulting engineers at that time, it is small wonder that shipowners hesitated, and therefore progress was slow.

"The striking improvement in these engines that has made absolute reliability possible is the system of mechanical-injection of the fuel invented by Sir James McKechnie. This invention has not only simplified the engine by abolishing all the air-blast injection compressor with all its pipes, receivers, etc., but has also secured a more economical engine. Messrs. Vickers have built about 500,000 b.h.p. of these engines, which are working satisfactorily in all parts of the world, and it is very gratifying to hear speeches such as those we have just listened to, proving that the owners are satisfied."



Anglo-American Oil Co.'s 10,050 tons Vickers Diesel-driven tanker "Seminole," the second of six sister motorships

The motorship "Seminole" has the following dimensions:

Displacement	14,000 tons
Deadweight capacity (maximum)	10,500 tons
Deadweight capacity (normal)	10,050 tons
Cargo capacity on 26-ft. draft	9,450 tons
Fuel capacity	750 tons
Cruising radius	68 days
Cruising radius	18,000 Nautical miles
Capacity of main tanks	434,000 cu. ft.
Capacity of summer tanks	52,000 cu. ft.
Total cargo capacity	486,000 cu. ft.
Length	425 ft.
Breadth (moulded)	56 ft., 8 ins.
Depth (moulded)	33 ft.
Draft	26 ft.
Contract speed	10.50 knots
Trial speed (on 26 ft., 2 in., draught)	11.24 knots
Brake horse-power	2,500 H. P.
Engine speed	118 R. P. M.
Cylinder bore and piston stroke	24½ x 39 in.
Auxiliary machinery	Steam driven
Auxiliary oil engine	Vickers-Petter

Regarding the main engine:—Fuel-injection is effected by means of a small four-throw pump driven by gearing off the cam-shaft drive. The oil is delivered—without any air—at a pressure of about 4,000 lbs. to the fuel-injection valves placed on the cylinder-head in between the air-inlet and exhaust-valves, depending on the power being developed by the engine. Each fuel-injection valve is driven by a bell-crank lever and push-rod, spring controlled, off the cam-shaft, placed at the top and front of the engine. The atmospheric air-inlet-valves and the exhaust-valves are similarly driven off the same cam-shaft. Lever gear is provided, operated from the starting platform, to cut-out any fuel-injection valves separately, and also, to alter the timing and period of injection, thus controlling the power developed. The air-inlet valves each take their suction from a short vertical stand-pipe, closed in at the top and fitted with a suitable number of narrow slots. The exhaust from the cylinders is led into a common pipe—one for each set of engines—suitably lagged, and then passes through the silencer and up the stack into the atmosphere. (*Continued on page* 563)

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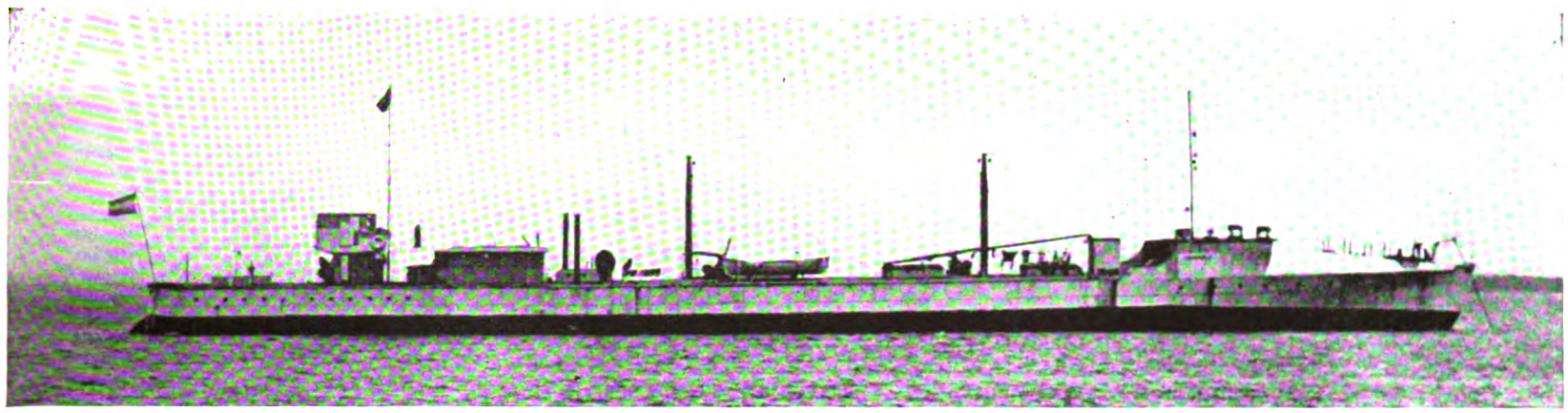


Motorship "Whipple," one of three U. S. destroyers converted to Wolverine motor-driven banana carrier

Conversion of American Destroyers to Motor Power

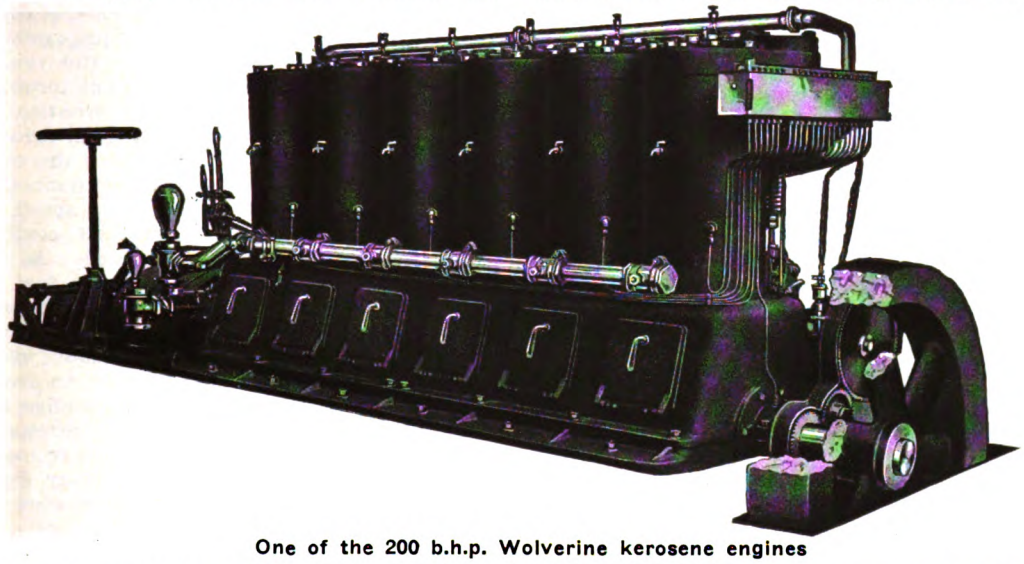
As has been illustrated in "Motorship," a number of German warships have been converted into economical freighters by removal of the old steam machinery and the installation of economical motor-power. This was proposed in connection with three American destroyers purchased some time ago by the New London Ship & Engine Company, but the actual work was never carried out.

Three other American destroyers, however, have been converted and are now in service in the fruit-carrying trade between Houston and Puntenaro, Mexico. It is probable that two additional destroyers recently purchased by the same owners will also be changed—as briefly indicated in our issue of June, 1921. These three old destroyers are the "Whipple," "Worden" and "Truxton," the other two being the "Perry" and "Stewart," and are operated under the Nicaraguan flag. The conversional work was carried out by the E. R. Clinton Shipbuilding & Dry Dock Company of Philadelphia to the order of Mr. M. T. Snyder, of Houston, Texas. Their route is about 750 miles each way, and three trips are made per month, or a total of 4,500 miles per month. Power for each of these vessels is now furnished by Wolverine kerosene engines in two units of 200 shaft h.p. each, which give the vessel a speed of 12 knots when carrying 15,000 bunches of bananas.

The illustrations which we give of the "Whipple" and "Worden" show that the outward appearance of the vessels has been very little changed, with the exception that the smoke-stacks have been removed and two exhaust-pipes placed in their stead. The principal dimensions are as follows:

Length over all	248 ft.
Breadth	22 ft. 3½ in.
Draught	6 ft.
Power	400 shaft h.p.
Capacity	15,000 bunches of bananas

Each of the engines is of the four-cycle electric-ignition type with electric starter, and is in 6 cylinders, 11-in. bore by 15-in. stroke, and turn a 60-in. diameter propeller at 330 R.P.M. through a mechanical reverse-gear. The weight of this equipment is about 8½ tons, or about 20 tons for the entire engine-room machinery, including auxiliaries. It was constructed by the Wolverine Motor Works, Inc., Bridgeport, Conn. We believe that the constructural changes were carried out at a moderate cost, while the machinery, including propellers and shafting, cost about $25,000. This, however, did not include the small Wolverine kerosene-driven blower-fan on deck for ventilating the cargo holds, nor a small Wolverine kerosene-engine for operating the anchor-hoists, bilge pumps, etc.



One of the 200 b.h.p. Wolverine kerosene engines

MOTORSHIP "KANGAROO" RE-CONDITIONED

The West Australian Government's twin-screw 5,800 tons Burmeister & Wain Diesel-driven motorship has been re-conditioned by John I. Thornycroft & Co., Southampton, England, in order to bring her in line with the Commonwealth's regulations. Also the accommodation has been increased and 52 passengers can now be carried. A large Hall refrigerating equipment has been installed, power for which is furnished by a new 200 b.h.p. Diesel engine and a 150 K.W. electric-generating set. The "Kangaroo's" power is 2,200 shaft h.p., giving her an average sea-speed of 9 knots. She was built before the war by Harland & Wolff.

——SAYS FIELDS PENDLETON

In pointing out the merits of the sailing-vessel, also shipping-general, Fields Pendleton, a well-known New York shipowner, said:

> "The real economic carriers of the future will be those of moderate speed with passenger and freight accommodations, and which will not require too much fuel nor a large crew. Such a ship should develop a speed of 14 or 15 knots in order to make them attractive to passengers."

This exactly describes the "express" type of combination passenger-cargo Diesel-driven motorships so frequently advocated by "Motorship."

MOTOR TANKER'S SPLENDID RECORD

By the time this appears in print the Vickers Diesel-engined tanker "Narragansett" will have made twelve Atlantic crossings in the service of the Anglo-American Oil Company. The results of her first eleven voyages make very excellent showing. She has covered a total distance of 38,465 nautical-miles at an average speed of 10.2 knots on a daily engine-consumption of 9¾ tons of fuel-oil.

NINE AMERICAN TUGS TO BE CONVERTED

Three tug-boats owned by the Carey Davis Tug Boat Company will be converted to Diesel power this fall; 200 b.h.p., 300 b.h.p. and 500 b.h.p. engines, respectively, will be installed. This company owns a fleet of 9 tugs, and the remainder will shortly be converted—probably during the coming year.

Motorship "Worden" at the fruit docks

MOTOR-TANKER "SEMINOLE" IN NEW YORK

(*Continued from page* 562)

Referring to the picture of the group of visitors, they are as follows:

Extreme top—
Members of crew.

Top (standing)
G. H. Orton (Vacuum Oil Co.), O. Doust (Ship's Steward), Mr. Thorold (from London), Surveyor from Bureau Veritas, G. D. Ali, Mr. Smith, F. S. Fales (all three Standard Oil Co. of N. Y.), F. E. Powell (Chairman of Anglo-American Oil Co.), Messrs. Clear and Huskinson, Messrs, G. H. Greene, W. C. Chaloner, E. M. Clarke and E. J. Sadler (all four Standard Oil Co. of N. J.). J. Morrell of Tide Water Oil Co. stands just in back of Messrs. Clark and Sadler. Fllowing Mr. Sadler is Chief-Officer Elliot and other members of the crew.

Middle (standing)
Messrs. J. A. Moffett, T. J. Williams and S. B. Hunt of Standard Oil Co. of N. J.), James Hamilton (Vice-Chairman of Anglo-American Oil Co.), Captain Hudson, Messrs. F. H. Bedford and F. D. Asche of Standard Oil Co. of N. J., Dr. L. Waldo, Mr. Plymert of Standard Oil Co. of N. Y.

Front (sitting)
Messrs. W. H. Settle, W. P. Hamilton, E. B. Brouard, L. K. Blood (all of Anglo-American Oil Co.), G. E. Pendergast (Marine-Oil Co.), G. E. Pendergast (Marine-Supt. of Union Petroleum S. S. Co.), Chief-Engineer Hoar.

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Manoeuvring of Tug-Boats and Harbor Service Craft

THE application of the oil-engine to tug boats and other types of small harbor craft, where fine manoeuvring qualities are an absolute necessity, has lagged so far behind its ever increasing adaptation to other classes of service that a few words of explanation as to why this condition exists together with a suggestion toward its improvement may be of interest. Every harbor of any consequence in the country has its quota of steam-driven tugs, ranging in number from a dozen or more at the smaller places to several hundreds in New York Harbor, while on the other hand, the oil-engined tug is decidedly a "rare bird" and unfortunately is regarded by some tug-boat interests as a hopeless proposition. There is, of course, a very definite reason for this state of affairs, and if this reason can be met and overcome, it will be only a matter of time, and in all probability a very short time, before the oil-engine with its superior operating economy will be driving the steam-engine from one of its most exclusive fields.

Primarily, the trouble has been the inability of the tug-boat with its relatively light hull to manoeuver with any degree of satisfaction or fineness when engined by a direct connected oil-engine of relatively large horsepower. The starting characteristics of oil-engines are inherently such that when solidly coupled to the propeller shaft, it is difficult to go through the frequently recurring routine of starting, stopping, and reversing incident to docking operations without experiencing a few unpleasant bumps with an occasional snapping of tow lines. This is, of course, due to the fact that a tug-boat is necessarily largely overpowered, inasfar as the requirements of its own hull are concerned, resulting in a tendency to be entirely too jumpy for comfort when manoeuvring in close quarters.

This tendency can be obviated somewhat by resorting to the use of compressed-air for very short periods of operation, but this practice necessitates the use of a starting-air equipment out of all proportion to the size of the engine, and is at best only a palliative and not a cure, and is in general impractical because it leaves too much to the judgment of the operating engineer. The ideal solution from the operating point of view is, of course, the electric-drive, but the high cost of such an equipment, together with the fact that the average tug-boat owner regards electrical apparatus in general as something more or less mysterious and beyond the abilities of his crew to operate and maintain, has prevented it from receiving favorable consideration as yet. What is needed, therefore, is an arrangement of drive which involves no serious increase in cost over the direct-connected engine, but which at the same time retains as nearly as possible the advantages of the electric drive as to ease and fineness of control.

Of course, the above criticism does not refer to oil-engines fitted with the conventional reverse-gear and clutch. However, such equipment is mechanically impossible, generally speaking, on heavy-duty engines of over 150 horsepower, and inasmuch as the ordinary tug boat engine will range between 150 and 600 horsepower, the possible solution of the problem by resorting to this type of drive may be disregarded. Also, if a reverse-gear for these larger engines were a mechanical possibility, there would still be the objectionable reduced towing effort when going astern which is characteristic of the planetary type of reverse-gear, and which is always objected to by the tow-boat man. Other types of gears have been devised, giving a one to one ratio on the reverse, but the planetary type is undoubtedly the most satisfactory, particularly in the larger sizes of 100 to 150 horsepower.

It might seem, then, that if the engine itself were made direct reversing, and a suitable clutch installed between the engine and the propeller shaft, most of the operating troubles could be eliminated. This is in fact the case, the difficulty being that until very recently there has been no suitable clutch available. Such a clutch, to function properly, must have the following characteristics:—

1. It must be capable of positive and instantaneous operation at all times.

New Type of Magnetic Clutch for Marine Oil-Engines

By CHAS. G. BARRETT

2. It must be capable of operation or control by the engine reversing lever.

3. It must be adaptable to remote control.

4. It must be capable of picking up the propeller shaft from at rest, with the engine turning at full speed, without shock or injury .

5. It must be practically wear proof in order to stand up under the severest conditions of service without necessitating frequent adjustments or renewals.

6. It must be noiseless in operation, of small bulk, light weight, and reasonably inexpensive.

It will be seen at once that there is no mechanical clutch available which meets all of the above conditions, and if such a type of clutch were to be used, it would, of course, be necessary to examine the various designs and select that which gives the nearest approximation to what is desired. This is not necessary, however, because of the fact that we have in the Sperry design a type of magnetic clutch which fulfills all requirements. This clutch, if applied to tug boat service in conjunction with a direct-reversing oil-engine, will give to the boat all the delicacy of control and manoeuvring of the electric-drive equipment, with the single exception of long periods of operation at very low speeds. Also, by the possibility of remote control, the actual manoeuvring of the boat may be done by the captain from the pilot house, leaving the reversal or speed control of the engine itself to be effected by the engineer on signals as usual.

With such an arrangement, the engine would, of course, be running continuously throughout periods of manoeuvring, the captain or engineer, according to the system of control in use, throwing in the clutch when required and with the engine previously adjusted to the proper direction of rotation. In addition to affording a delicate manoeuvring control, this system of operation has the added advantage of greatly reducing the use of starting air, which is accomplished in two ways:

First, when manoeuvring with direct-connected engine, it often happens that the engine is stopped and then started up again in the same direction a few seconds later. On the other hand, when using the magnetic clutch and keeping the engine constantly running, it is only necessary to press the control-button and throw in the clutch when desiring an additional push in the same direction, thus saving the starting-air which would otherwise be required.

Second, with the direct-connected engine, the greater part of the reversals will be made after the engine has been at rest for a short time, necessitating what is in reality a fresh start in each instance, while with the clutch arrangement, each reversal will be made with the engine already in operation. It is a fact that an oil-engine, particularly of the solid-injection type, will reverse more quickly and positively and with a decidedly less consumpton of starting air, if reversed directly from one direction of operation to the other, than if allowed to stand idle for a short time between the two periods of operation, the promptness of the start varying in an inverse ratio to the length of the period of idleness. Incidentally, with the main engine always running while manoeuvring, and with its attached compressor consequently always supplying air to the tanks, it is quite possible on a moderate tank capacity to go through these manoeuvring periods without the necessity of starting up or bothering with the auxiliary compressor—a feature which will be much appreciated by the operating-engineer.

The Sperry clutch referred to above is a comparatively recent development and perhaps deserves a few words of description and explanation. Inasfar as its clutch action is concerned, its construction and operation are simple and obvious, consisting essentially of a specially designed electro-magnet and armature. The magnet element is mounted on the engine shaft, and the armature on the driven shaft, the design being such that a strong magnetic field is set up around the winding in the magnet element, completing its circuit across the permanent air gap separating the two parts and through the armature on the driven shaft. The pull of this magnetic field is sufficient to cause the two clutch parts to rotate at exactly synchronous speed but without mechanical contact between the two elements. Any angular displacement between the two members tends to elongate the lines of force and is resisted by the magnetic action which produces the required torque. This angular displacement is always present, and increases with the load up to the point of maximum clutch capacity, when slippage occurs. It is, of course, only necessary to choose a suitable factor of safety in the selection of a clutch for a given drive to avoid working the clutch to its "pull out" capacity.

However, the clutch will function as a magnet only when the two parts are at approximately synchronous speeds, so that if its magnetic action were its only feature, it would be impossible to have the engine pick-up its load while running. The method by which the clutch is given torque characteristics at non-synchronous speeds is its especial point of interest and is the feature which makes it so particularly adapatable to marine service. Briefly stated, this is as follows:

The rotating magnet element on the engine-shaft produces a rotating magnetic field which may be compared to the rotating field of the stator winding of the induction motor. Whenever there is any speed difference between the two halves of the coupling, this rotating field sets up strong induced currents in the specially constructed armature element constituting the driven half, which currents, of course, react on the field and produce a torque exactly as in the case of the induction motor, the value of the induced currents and the resultant torque depending, of course, on the speed differential. We thus have a clutch which functions as an induction motor when throwing on the load with the engine running, and which quietly and without shock brings the driven shaft up to engine speed, and then automatically changes over and continues operation as a pure magnetic clutch. As compared to electric drive, it is evident that this clutch gives practically the same advantages for manoeuvring purposes, while at the same time it permits continued operation at full load without the same percentage of power losses. An exciting current of a few hundred watts will suffice for a clutch transmitting several hundred horsepower, and inasmuch as this is the only power loss involved, its transmission efficiency may be regarded as practically one hundred per cent.

In regard to the question of exciting current, every oil-engined boat of any size will have a lighting outfit, including a storage battery which will serve as a satisfactory source of supply. Or, if necessary or desirable, a small generator may be mounted on the main engine and directly connected up to the clutch winding, so that this feature need not be a question of any concern to anyone contemplating the use of such a clutch.

There is thus available a type of clutch which eliminates the mechanical weaknesses of the friction clutch, such as wear on the clutch surfaces and necessity for readjustments, by maintaining a positive air gap, without mechanical contact between the clutch members. Also, its electrical operation inherently insures instantaneous, positive and extremely delicate control over the propeller operation, which is all that is needed to adapt a powerful engine to a relatively light hull. The reversibility and speed control of the direct-reversing oil-engine are both eminently satisfactory, and when these features are supplemented by an electro-magnetic clutch such as is described above, making the propeller operation independent of the engine and placing the manoeuvring of the boat directly in the hands of the captain, a tug so equipped will certainly have all the excellent manoeuvring abilities of the electric drive without being handicapped by its increased first cost, its operating power loss, and its increased complexity due to the addition of the usual electrical apparatus.

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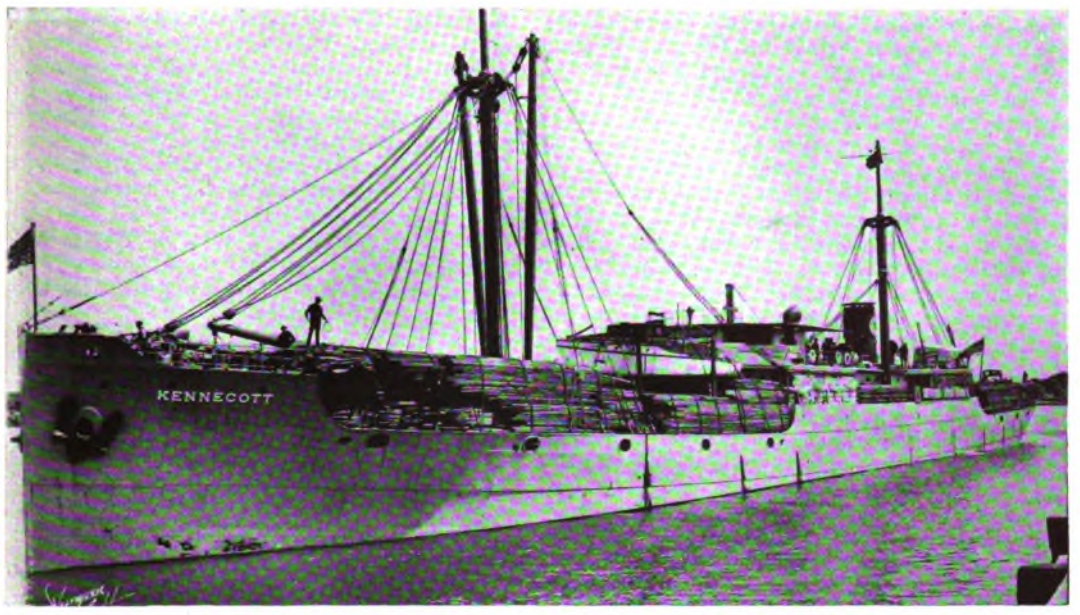
Operation of the American Motorship "Kennecott"

Visit to New York of This Interesting New 6,010-Tons Diesel-Driven Vessel

AS may be anticipated, the recent visit to New York of the new all-American motorship "Kennecott" caused considerable interest in this shipping district and she was inspected by a considerable number of shipowners and shipbuilders. This splendid vessel, it may be remembered, was exclusively fully described and illustrated in our May issue. She is of 6,010 tons d.w., was built at the Todd Shipyards Corp., Tacoma plant, and Diesel-engined by McIntosh & Seymour of New York, the total propelling power being 2,200 i.h.p. Her fuel bill is about $110 per day.



Alaska Steamship Co.'s Diesel motorship "Kennecott" loaded with 3,500,000 ft. of lumber and 1,200 tons of copper ingots

One of the most note-worthy features in connection with the operation of this ship on her first voyage is that she has been exclusively using regular boiler-fuel of 16.7 gravity, and we will place on record the fact that to date the engines have run without any trouble on this heavy fuel, contrary to the opinions of many shipowners that this could not be done. On the first day she logged 292 nautical-miles on 9 tons of fuel.

We will give a few details regarding the voyages made to date. On her maiden run she left Bellingham and made San Pedro in 4 days 5 hours with 3,500,000 ft. of lumber. Then she discharged and returned light to San Francisco, a distance of 335 miles, in 1 day, 6 hours, 45 minutes. At San Francisco she loaded 600 to 700 tons of general cargo and proceeded to Victoria, then Seattle, a distance of 742 nautical-miles, which she covered in 2 days 16 hours. At Seattle she loaded part of a cargo of 3,000,000 ft. of lumber, and it is interesting to note that it only took 31 bbls. of fuel to operate the auxiliary machinery for loading; the rest of the lumber cargo was loaded at Aberdeen (Grays Harbor), Wash. Next, she called at Tacoma and took aboard 1,200 tons of copper bars. She left Grays Harbor on May 5th, arrived at Panama on the 20th, and reached New York on the 28th, her engines averaging 126 to 130 revolutions per minute. This latter voyage occupied 23 days and 7 hours, the total distance being 5,994 nautical-miles—the longest leg being from Aberdeen to Panama, a distance of 3,960 miles.

The fuel used cost $1.78 per bbl. Unfortunately, on these voyages no accurate fuel-consumption was obtained, but the actual consumption was about 60 bbls. or 8½ tons per day. Because of the heavy fuel a special exhaust heating-device is fitted, which heats the oil before it flows to the day-tank. The result of heating this oil is expansion. Consequently, the day-tank when full of heated oil actually contains considerably less than its designed barrel capacity. In order to secure accurate figures on her next trip, the fuel will be measured prior to entering the day-tank, and we hope to publish the results. The following is an extract of the voyage from Aberdeen to New York, furnished us by the Chief-Engineer of the ship.

Abstract of Engine-Room Log—M. S. Kennecott, Voyage No. 2, Aberdeen to New York

Date May	Port R.P.M. Average	Stbd. R.P.M Average	Distance Miles
5	.....	.....	....
6	132	128	267
7	127	123	253
8	129	123.5	252
9	128.5	123.5	255
10	130	126.6	261
11	131.3	126.5	267
12	132	127.5	259
13	133	131	270
14	132.1	130.1	261
15	132.8	130.8	267
16	132.2	130.1	260
17	131.1	129.7	259
18	131.1	129.6	250
19	132.4	130.9	265
20	133	131	....
21	124.4	123.5	129
22	122.8	121.8	221
23	126.9	126.3	226
24	130.2	130	247
25	132	130.5	258
26	131.5	129.5	250
27	131.1	129	238
28	130.7	129	271

From Gray's Harbor to Balboa, 15 days, non-stop run; from Cristobal, Panama, to New York, 8 days, non-stop run.

"MEDWAY" CHANGED TO "MYR SHELL"

The Vickers 1,600 shaft h.p. Diesel-engined tanker "Medway," 2,636 tons gross, owned by the Anglo-Saxon Petroleum Co., has had her name changed to "Myr Shell."

HUDSON BAY CO.'S MOTORSHIP

"Lady Kindersley" is the name that has been given to the 616 tons gross wooden motor-auxiliary schooner recently built for the Hudson Bay Co.'s Vancouver station, by the British Columbia Engineers & Shipbuilders Ltd. of that city. A Beardmore oil-engine is installed.

MOTORSHIP OF NEW TYPE

What is said to be a new motorship of entirely new type was recently launched at Tonning to the order of Leopold David. This vessel is of 600 tons net and of 750 i.h.p. in twin-screws, and has a speed of 12-knots.

AMERICAN OIL-ENGINE BUILDERS, PLEASE NOTE

Mr. James A. Kennedy, president and manager of the Inter-Island Steam Navigation Co., Honolulu, H. I., recently came to the U. S. A. to have plans prepared for a new 3,000 tons 15-knot passenger vessel, but will place no order until returning to Honolulu. We suggest that he be urged to adopt Diesel or Diesel-electric power. The vessel will cost nearly $1,500,000.

"KOSMOS I" A SMALL GERMAN MOTORSHIP

During March last, the 900 tons-gross motorship "Kosmos I" was launched by the Actiengesellschaft Eiderwerft of Tonning. Two Diesel engines are installed, driving twin screws.

NEW FRENCH SUBMARINES

Construction is to be started immediately on twelve of thirty-six large ocean-going submarines for the new French naval programme. We understand that Schneider & Sulzer two-cycle type Diesel-engines will be installed.

SECOND DOXFORD SHIP LAUNCHED

The second of the standard single-screw motorships for the Rederiaktiebolaget Transatlantic was launched May 21st by Wm. Doxford & Sons, of Sunderland. She is a duplicate of the "Yngaren," described elsewhere in this issue.

DISCUSSION OF PAPERS READ BEFORE THE S. N. A. M. E.

Owing to the typewritten reports of the discussion on the various papers recently read before the Society of Naval Architects and Marine Engineers of New York not yet being available from the Secretary, we are obliged to hold over publication until our next issue.

"DWARKA" AND "DUMRA"

The above will be the names of the two 2,050 tons d.w. motorship building by Chas. Hill & Co. Ltd., Bristol, for the British India Steam Navigation Co. Ltd., in which twin 600 i.h.p. North British Diesel-engines are to be installed.

BRITISH FIRM BUILDING 5,000 SHAFT H.P. ENGINE

Plans have been completed and the preliminary work started on a 5,000 shaft h.p. six-cylinder two-cycle Diesel-engine of the single-acting type by a well-known British steam-engine building concern in the Newcastle district, who recently acquired an European license. We hope to say more about this engine at an early date, but it will not be completed for about two years.

ANOTHER ITALIAN FIRM ORDERS MOTORSHIP

An 8,100 tons d.w.c. motorship similar to the "Ansaldo-San Giorgio" class of freighters has been ordered by the Societa di Navigazione Roma, from Ansaldo-San Giorgio Ltd. of Spezia & Turin. She will be named "Veio," and twin 1,100 i.h.p. A.S.G. two-cycle Diesel engines will be installed, but steam will be used for the auxiliary machinery.

RECONDITIONING BOARD'S STEAMSHIPS

In rejecting bids of approximately $20 d.w. ton recently offered for the three 12,000 d.w.c. steel steamships "Marica," "South Bend" and "Edellyn," Admiral Benson stated that the lowest the Board could accept was $47 per d.w. ton and that the cost of reconditioning these ships would be about $30 per ton. Furthermore, he stated that if it is necessary to undertake extensive reconditioning of ships, the Shipping Board will install the electric or modified form of Diesel power, because the ships are admirably suited for this change. The vessels are only three years old. The original price was about $157 per d.w. ton.

FIVE-THOUSAND HORSE-POWER OPPOSED-PISTON DIESEL-ENGINES

Work has been commenced on a 4,000 to 5,000 h.p. opposed-piston type of marine Diesel-engine by Cammell-Laird & Co., Birkenhead, England. This engine is of the Cammellaird-Fullagar design with four cylinders, and will operate at 70-90 R.P.M. , The cylinder diameter will be 26 ins. and each of the eight pistons will have a stroke of 42 ins. or 84 ins. per cylinder. This gives a cylinder output of over 1,000 h.p. In the tests with the 1,000 h.p. engine of this design, a fuel-consumption of 0.39 lb. per shaft h.p. hour was recorded, which is very low for the two-cycle system and almost equal to the best four-cycle practice.

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The North British Diesel-Engine

Description of One of the Twin 2,300 h.p. Motors of the Passenger-Cargo Liner "Domala"

IN our May issue we published completely illustrated details of the first of the British India Steam Navigation Company's new combination passenger and cargo motor-liners, namely the "Domala," a vessel of 10,500 tons d.w.c. and 13½ knots loaded speed. But only a brief description was given of the main propelling units, which consist of a pair of North British Diesel-engines, together developing 4,600 i.h.p. at 96 R.P.M. These engines are of particular interest as they are the first of their type to be completed and installed, being of a new design, and are the products of a large plant in the Clyde district erected to construct Diesel-engines exclusively. Many more engines of this power and in smaller sizes are now nearing completion.

The North British Diesel-engine follows the line of the simplest form of internal-combustion engineering, being of the 4-cycle, single-acting, crosshead type, although in the constructional and detailed features to be described, certain departures from general practice and many points of individualistic merit, which have been incorporated in the design, will be made clear.

These engines are each of eight working-cylinders of 26½ ins. diameter, with 47 ins. piston-stroke, developing normally at 96 r.p.m. 2,330 i.h.p. each, 292 i.h.p. per cylinder, or a total power for the ship equivalent to 4,500 i.h.p. with steam machinery. The shaft horse-power is 2,000 b.h.p. or 250 b.h.p. per cylinder, and the piston speed at 96 r.p.m. is 817 ft. per minute. The weight of each engine is approximately 300 tons, or 336 lbs. per b.h.p. In connection with this it is to be noted that the engine is rated at the very moderate mean-effective pressure (on a b.h.p. basis) of approximately 80 lbs. per sq. inch. In considering the foregoing figures it must be remembered that the fuel-injection air-compressors are not driven from the main engines, but are in twin sets in duplicate driven by auxiliary Diesel-engines of the same type as the main engines, but with trunk pistons and run at 250 r.p.m.

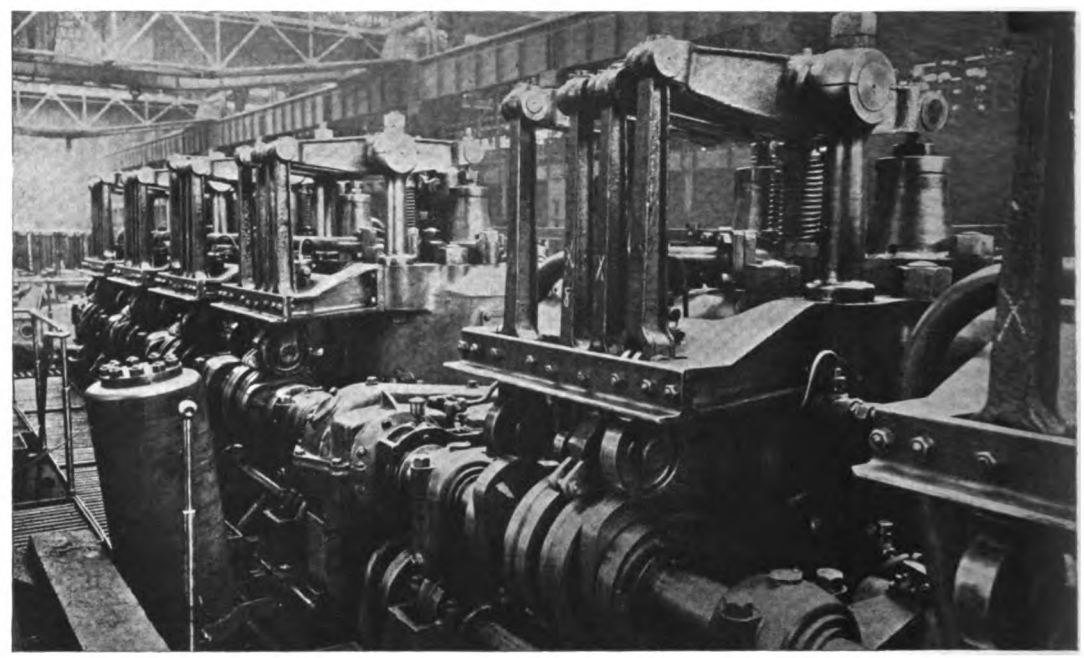
The general appearance of this fine motor can be seen from the illustrations published on pages 384 and 386 of our May issue. It will be appreciated that single-acting Diesel-engine construction, whilst yet far from the same state of rigid standardization as applies to its reciprocating steam rival, is gradually crystallizing into generally accepted practice. The framing of this engine has the unique feature of combining cast-iron for rigidity with turned steel through-bolts to take the tension, without the one performing any of the functions proper to the other. The bedplate is in four sections bolted together.

Between each crankthrow are the usual trestle columns, ten in number. Each leg is cast separately and the two are bolted together. Between these trestles, bolted to a flange, on each are the water-cooled ahead and astern guide-plates, and passing through the legs are the through-bolts supported in the middle for rigidity. These through-bolts in turn carry an entablature in four pieces into which the cylinders are set. The through-bolts extend to the bottom of the bedplate as shown. It will thus be clear that the cast-iron cannot take any tension. All such stresses are borne by the through bolts. The function of these trestle castings forming the framing of the engine is to carry the guides and to give rigidity to the whole engine, and for this purpose the trestle columns are constructed of castings of three-quarters-of-an-inch in thickness. In this way any difficulties consequent upon asking two such different materials as cast iron and steel, to share the piston loads, are entirely obviated. The cylinders of cast iron have close-grained iron liners pressed in and the head is secured to them by eight studs.

Notable construction is incorporated in the cylinder-head design, the joint between it and the cylinder being made lower down than usual, so permitting of large recesses for the inlet and exhaust valves, which are widely spaced from the centre to give ample cooling around the fuel-valve, as will be readily seen from an inspection of the elevation and plans on page 386 of our May issue.

To turn to a consideration of the running-gear, the crankshaft, as is becoming more common practice for marine work, is of the completely built up type; the web being shrunk on to the journals, and the pins, and secured by dowels. It is built up in two interchangeable pieces each of four throws, and drilled throughout for forced lubrication. The connecting-rod is of approximately 4.5 cranks in length, drilled for forced-lubrication to the top end bearings. It is not forked at the top end, having simply a flat to which the crosshead bearings are bolted. All the bearing-bushes are of cast-steel, white-metal lined The piston accommodating eight rings has a large concave recess and is attached by studs to the large flange on the top end of the piston-rod. Attachment of the piston-rod to the crosshead and guide slippers calls for special mention. The gudgeon-pin is a press fit on the end of the piston-rod and the slipper forms a vertical cap to the forked end of the rod, the whole being held together by six bolts.

In accordance with the very best practice, the cylinders are entirely isolated from the crank-chamber by a diaphragm-plate in halves with a gland for the piston-rod. Any passage of oil from the forced-lubrication system to the main cylinders is prevented and any piston-ring leakage of partially burnt or carbonized oil cannot contaminate the crankchamber system. The diaphragm-plates being in halves permit of the main pistons being withdrawn from below or alternatively by disconnecting the top gear and lifting off the heads they can be withdrawn from above.



Camshaft and valve operating gear of the North British engine

As regards the pistons, these are internally water cooled, a telescopic-pipe and jet system being employed, as will be clear from the illustrations already referred to.

In the cylinder-head in separate cages are the usual fuel, starting-air, inlet, exhaust and relief valves, operated through cams, rods and levers. The fuel-valve is of the outward opening type, so that the usual double-levers are fitted. Since the camshaft is lower than the cylinder-heads, the cam-rollers are attached to the end of forked cast-steel push-rods, pin jointed to the ends of the four valve-levers per cylinder. The push-rods are guided, as shown, by an angle plate. The valve-levers are pivotted on the fulcrum shaft. On the cam-shaft, driven by a vertical shaft with a combination of spur and spiral gearing in the centre of the engine, are two sets of cams for each cylinder, one for ahead and the other for astern.

Reversing of the valve-gear is accomplished in a novel manner. The cam-shaft bearings are contained in levers free to swing in an arc centrally pivotted on brackets in the cylinder entablature. Underneath the camshaft runs a shaft with eccentrics which support the cam-shaft bearings. Rotation of this shaft and its eccentrics causes the cam-shaft to fall, fuller rotation by means of a pin running in a slot serves to pull the cam-shaft froe and aft and so put in the cams for the opposite direction of rotation under the rollers. In this position the cylinder relief-valves, which are horizontally placed in the front of the cylinder-heads, are opened against their springs by a special cam, so relieving any pressure that may be in the main cylinder. Continued revolution of this shaft lifts the cam-shaft again into its operating position. This secondary shaft carrying the eccentrics is rotated through geared-up spur-wheels by a compressed-air piston, with its motion, suitably damped by an oil-cushioning cylinder. In the normal running position the eccentrics for raising and lowering the cam-shaft are vertical, so that the thrust due to the valve springs does not tend to revolve this shaft.

When compressed-air, at from 250 to 300 lbs. per sq. inch, is turned on, small plungers attached to each push-rod of the cylinder-head starting air-valves operate, and the starting-air valve-rollers are brought into contact with their appropriate cams; the starting-air valve in the cylinder-head of that line, the crank of which is at the correct angle, opens, starting-air enters the cylinder and the engine rotates; on gaining speed, the air is cut off from half the engine and fuel admitted; when combustion takes place the remaining four cylinders are immediately changed from air to fuel.

The fuel-pumps, one for each main cylinder, are driven by skew-gearing from the vertical shaft. and are located below the cylinder entablature and are controlled on the suction-valves in the usual way from a hand-lever on the starting platform. An Aspinall governor is fitted to cut-out the pumps in the event of overspeed.

Forced-feed lubricators for the main cylinders are driven-off a longitudinal shaft from the same gear as the fuel-pumps. A flywheel in halves at the after end of the engine has worm-teeth cut in the periphery and an electric-motor suitably geared serves to drive the turning-gear. As is required by the adoption of forced-lubrication, the engine is totally enclosed. Light, easily removed sheet iron doors give ready access.

These engines are the product of the only factory on the Clyde specially designed and laid-down for the building of marine Diesel-engines, and have been designed and constructed without the assistance of any license, foreign or otherwise.

Before installation on board these engines were subjected to severe and prolonged tests in the makers' works, including a continuous full-power run of seven days against a Heenan & Froude water-brake with most satisfactory results.

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To summarize the leading figures: The revolutions varied from 95 to 97 per minute; the average of the cylinder mean pressures was 101.5 lbs. per sq. inch, giving an i.h.p. of 2,550. The blast-air was maintained at 1,000 lbs. per sq. inch, and the starting-air at 250 lbs. per sq. inch.

The following are the principal other pressures and temperatures:

Pressures, lbs. per square inch

Lubricating-oil	15.5 lbs. per sq. in.
Circulating water to cylinders	17.5 lbs. per sq. in.
Circulating water to pistons	37 lbs. per sq. in.

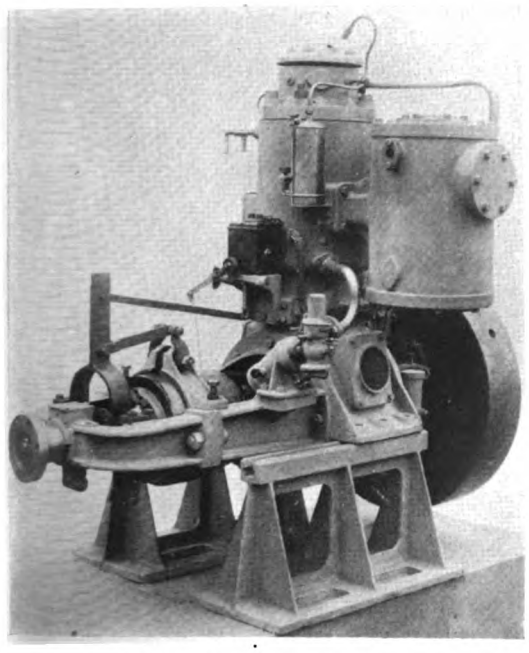
Temperature in Degrees Fahrenheit

Atmosphere	73
Crankcase	91
Circulating-water to cylinders	53
Circulating-water from cylinders (average)	117
Piston cooling inlet	52
Piston cooling outlet	144
Guides outlet	78
Lubricating-oil inlet	68
Lubricating-oil outlet	97

The fuel-oil consumption was 0.42 lb. per b.h.p. hour, or taking a mechanical-efficiency of 80% as recorded, 0.33 lb. per i.h.p. hour. The fuel used was Anglo-Persian of a density of 0.90. The combustion was smokeless and the engine ran noiselessly and steadily. Manoeuvring trials were successfully carried out, the engine reversing readily from ahead to astern in 10 seconds.

As those who read our previous article will remember, the whole complex machinery equipment of this liner is on an equal plane with the main engine. The pumps are all separately and electrically driven, suppied with current from Diesel-electric generators by the same makers.

Being installed in such important ships, the performance of this and similar machinery at sea will be watched with intense interest, and we look forward to being able to record in due course the complete success of this and of the many other sets of Diesel machinery for the same and other progressive shipowners now on hand at this engineering plant, namely, the North British Diesel Engine Works, Whiteinch, Glasgow, Scotland.

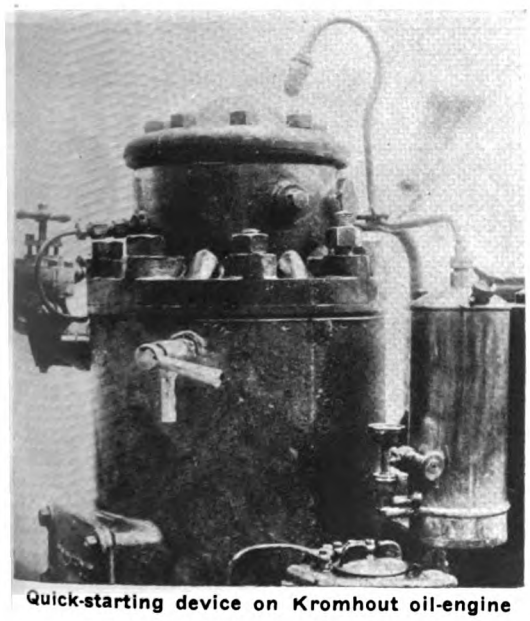


Kromhout marine oil-engine equipped with quick-starting device

NEW QUICK-STARTING DEVICE

With surface-ignition oil-engines, combustion is dependent upon a bulb, disc, ball or tube in the cylinder-head that is kept hot by the heat of the combustion itself, so generally speaking some form of outside ignition or heating is necessary to start the engine, as the heat of compression of the air is insufficient with the pressure used to cause combustion of the fuel. Consequently many engines of this type require ten to twenty minutes heating of the ignition-surface before they can be started. Various devices have been produced to overcome this slight delay, which after all is usually unimportant. Some makers use spark-plug, others an electric-coil, while several have adapted a form of torch that heats the ignition-surface in a very short time.

This latter system has been developed by D. Goedkoop, Jr., Amsterdam, Holland, builders of the Kromhout surface-ignition oil-engines.



Quick-starting device on Kromhout oil-engine

New Danish Burmeister & Wain-engined motorship "Java" fitting-out at Copenhagen. In the background in front of the church is an 800-ton wooden auxiliary for the East Asiatic Co. She is to be Holeby Diesel-powered

Vessels in Service Powered with Winton Diesel-Engines

Name of Ship	D. W. C. Tonnage	Shaft H. P.	Owner	Builder
"Mazatlan"	1500	700	Long Beach Shipbldg. Co., Long Beach, Cal.	Long Beach Shipbldg. Co., Long Beach, Cal.
"Mt. Baker" (Ex-"Mt. Shasta")	4800	1000	Globe Line, N. Y. C.	Supple-Ballin Shipbldg. Co., Portland, Ore.
"Mt. Hood"	4800	1000	Gaston, Williams & Wigmore, N. Y. C.	Supple-Ballin, Shipbldg. Co., Portland, Ore.
"Trolltind"	3350	1000	American Motorship Co., Christinia, Norway	Elliott Bay Shipbldg. Co., Seattle
"Wm. Donovan" (Ex-"Kirketind")	3350	1000	DonovanLum ber Co., Aberdeen, Wash.	Elliott Bay Shipbldg. Co., Seattle
"Semmeltind"	3350	1000	American Motorship Co., Christiania, Norway	Elliott Bay Shipbldg. Co., Seattle
"James Timpson"	1700	1000	I. T. Williams & Sons, N. Y. C.	Standifer-Clarkson Con. struction Co.
"Chas. S. Gawthrop"	1960	600	American Car & Foundry Co., Wilmington	Jackson & Sharp Plant of Amer. Car & Fdry Co., Wilmington, Del.
"Sherewog"	1700	600	R. Lawrence Smith, 17 Battery Pl., N. Y.	Savannah Engr. & Con. Co., Savannah, Ga.
"Adrien Badin"	2100	600	Compagnie France, Atlantique, Paris	Peninsular Shipbldg. Co., Portland, Ore.
"Erris"	2100	600	Erris Motorship Co.	Peninsular Shipbldg. Co.
"Pechiney"	2100	600	French Interests (Amer. Agent J. Cablat, 2 Rector St., N. Y.)	Peninsular Shipbldg. Co.
"Esperanca"	2300	600	French Interests (Bowman Bros. Agents)	Peninsular Shipbldg Co.
"Hussar III" (Ex-"Haida")	Yacht	600	E. F. Hutton, 61 Broadway, N. Y.	Kyle & Purdy
"Elfay"	Yacht	125	Russell A. Alger, Jr., Detroit, Mich.	Herreshoff Mfg. Co., Bristol, R. I.
"Guinivere"	Yacht	600	Edgar Palmer, New York	Geo. Lawley & Sons Corp.
"Marold II"	Yacht	178	C. Harold Wills, 1760 Jefferson Ave., Detroit, Mich.	John Dialogue & Sons
"Whitemarsh"	Yacht	125	E. W. Marland, Marland Refg. Co., Ponca City, Okla.	Unknown

This gives 13 merchant motorships aggregating 35,110 tons d. w. c., and of 10,300 shaft horse-power, and five yachts aggregating 1,628 brake horse-power.

Vessels Under Construction To Be Powered with Winton-Diesel Engines

Name of Ship	D. W. C. Tonnage	Shaft H. P.	Owner	Builder
"Nourmahal"	Yacht	700	Vincent Astor, Rhinebeck, N. Y.	Robt. Jacobs, City Is., N. Y.
Seven Concrete River Steamers	600 tons each	1000 each	Quartermaster Dept., A. T. S., U. S. Army	Newport Shipbuilding Co.
Yacht	....	500	Tams, Lemoine & Crane (Designers)	

The Winton Engine Co., are also building 4 stationary-type Diesel engines of 200 b. h. p., each for R. T. Wilson Co., 120 Broadway, N. Y. C.

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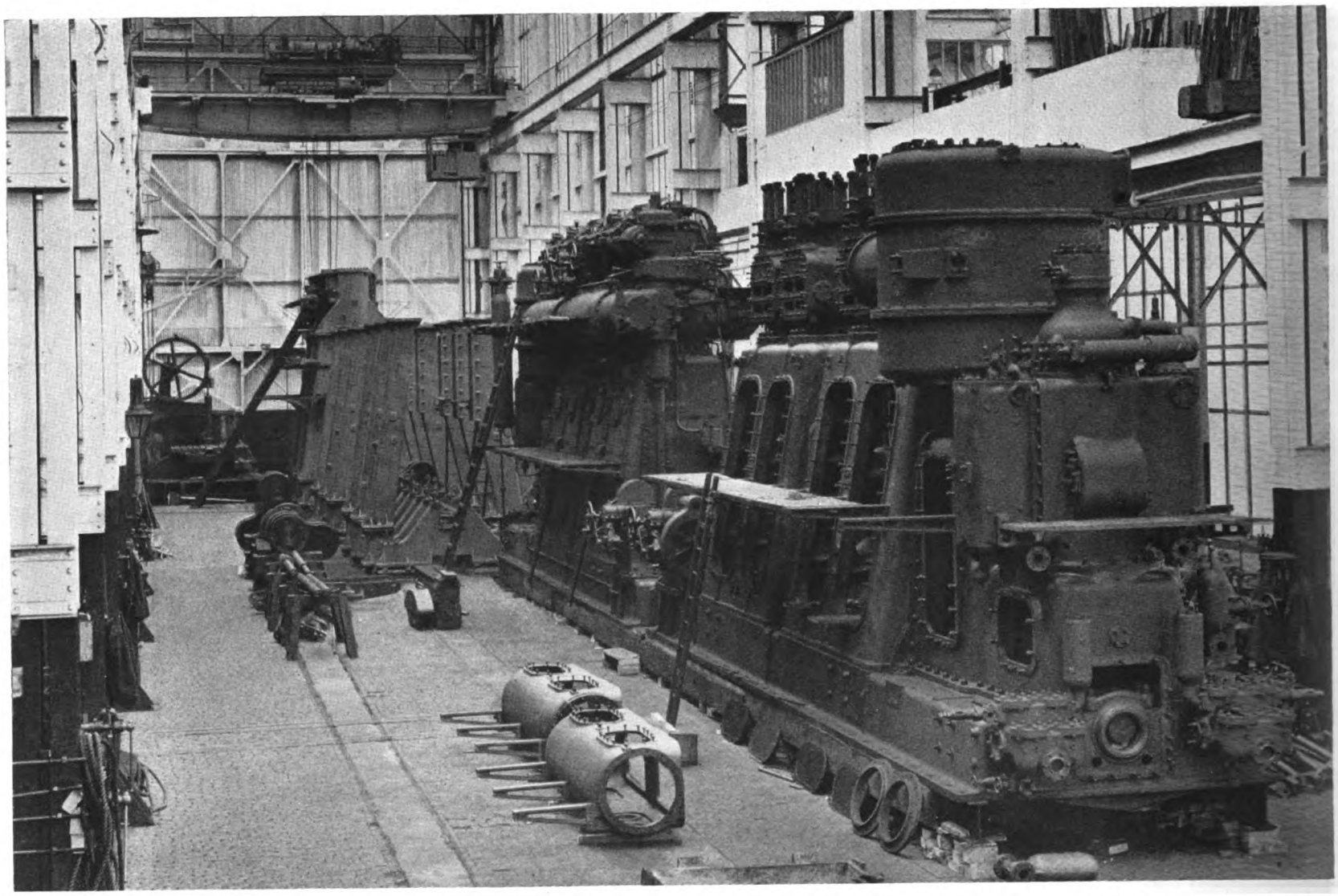

Engine erecting-shop of Sir Wm. Armstrong, Whitworth & Co., Newcastle-on-Tyne, England, showing a pair of 1,000 shaft h.p. Sulzer-Diesel marine-engines in foreground. These engines are fitted in the motorship "Conde de Churruca," launched for the Cia Generale de Tabacos de Filipines

NEW SPANISH MOTORSHIP BUILT IN ENGLAND

A new twin-screw motor-tanker named "Conde de Churruca" was launched on June 6 by Sir W. G. Armstrong, Whitworth & Co., Newcastle, England, to the order of the Cia Generale de Tabacos de Filipines, of Barcelona, Spain and Manila, P. I. She has the following dimensions:

Length .....370 ft.
Breadth .....48 ft. 3 in.
Depth .....30 ft.
Power.....2,000 shaft h.p.

This vessel is propelled by twin Sulzer-Diesel engines built under license by Armstrong, and is constructed on the Isherwood system, with machinery aft. For auxiliary purposes and for steam-heating the coils there is a donkey-boiler of 2,340 sq. ft. area burning oil-fuel. In addition there are two 100 b.h.p. Armstrong-Sulzer four-cylinder Diesel-engines driving 70 k.w. electric-generators at 300 r.p.m.

EAST ASIATIC COMPANY'S MOTORSHIP ORDERS

An announcement appears in the New York "Journal of Commerce" of June 20th to the effect that the East Asiatic Company had cancelled contracts for the construction of 17 motorships out of a fleet of 22, of which five had been delivered. However, we have been advised that this cancellation was made because the builders could not complete them at the original low prices made in 1915.

HAMBURG-AMERICAN NEW FLEET

According to Dr. Wm. Cuno, chairman of the Hamburg-American Line, plans have been made for the construction of a large fleet of ships from 5,000 to 12,000 d.w. Eight will have Diesel-engines and some will have reciprocating steam engines.

GERMAN 2,500 TONS MOTORSHIP LAUNCHED

To the order of J. M. J. Blumenthal of Hamburg, Germany, the 2,500 tons d.w. motorship "Ida Blumenthal" was launched on April 30th at the yard of the Lübecker Maschinenfabrik Gesellschaft, Lübeck. A Diesel-engine built at the same plant is installed.

GERMAN 9,000 TONS MOTORSHIP LAUNCHED

A motorship of 9,000 tons, named "Behrenfelds," was launched by the J. C. Tecklenborg A. G. Geestemund, Germany, during May, to the order of the Hansa Steamship Co. of Bremen. The Tecklenborg Co. and licensees of the Carels two-cycle Diesel-engine who built the Standard Oil Co.'s big motor-tanker, "Wotan."

SPECIAL PACIFIC-COAST NUMBER OF MOTORSHIP

TO BE PUBLISHED JULY 25th, 1921

(*Last Advertising Form Closes Friday, July 15th*)

Because of the Number of New Diesel-Engined Motorships Now to Be Laid Down and the Existing Steamers to Be Converted to Motor Power on the West Coast of the U. S. A., We Have Decided to Make Our August Issue a Special Pacific Coast Number. Full Details, Plans, etc., of These Interesting Vessels Will Be Given.

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A MOTORSHIP CONSTRUCTION BOOM HAS COMMENCED ON THE WEST COAST

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Injection and Combustion of Fuel-Oil

Experiments With Solid-Injection and Air-Blast in Marine Diesel-Engines

By ENGR.-COMMANDER C. J. HAWKES, R.N.

PART IV.

(*Continued from page* 483, *June issue*)

IN VIEW of the improved results obtained with the 0-016 inch-hole sprayer it was decided to carry out a series of comparative tests with this sprayer and the 0-019 inch-hole sprayer. The results are given in Tables 3 and 4, but before referring to these results it is proposed to give any necessary particulars of the fuel pumps, etc., used during the tests.

Fuel-Pump.—The fuel-pump used during the first series of tests had a plunger 17/32 inch in diameter and 1-inch stroke. The volumetric efficiency of a fuel-pump decreases as the pressure in the system increases, and this has to be taken into account when working with higher pressures. In service it is necessary to have a margin for leakages of glands, valves, etc., and for this reason a larger pump-plunger is a distinct advantage, especially as the adoption of higher fuel-pressures in existing engines provided with the standard fittings, which were originally designed for lower working-pressures, would increase the chances of leakages occurring.

A ½ inch bore fuel-pump was used during the tests recorded in Table 4.

Fuel-Valve Spring—During the tests with the 0-019 inch-hole sprayer a 618 lb. spring was used, but with the 0-016 inch-hole sprayer the spring was, for the reasons previously stated, washered up to give a load of 750 lbs.

Compression—During all the tests recorded in Tables 3 and 4 the compression pressure was 380 lbs. per square inch at 380 r.p.m.*

A series of tests was carried out with the 0.019 inch and 0.016 inch-hole sprayers at about 100 b.h.p., 90 b.h.p., 75 b.h.p., 50 b.h.p., 25 b.h.p., and the maximum possible powers. The results are shown in Table 3. The fuel-consumptions obtained with the two sprayers during the tests included in Table 3 have been plotted and are shown in Fig. 12.

The success of the solid-injection engine in service, from the point of view of smokeless combustion, depends very largely on the fuel-valve and fuel-pump design, correct settings, clean sprayers and tight joints in the system.

During the 50 b.h.p. and 25 b.h.p. tests it was found necessary to work with a later injection to enable the engine to run steadily at these powers. Also, during the 25 b.h.p. tests it was necessary to allow a small quantity of fuel-oil to leak off from the pressure side of the pump, as with the larger fuel pump and the existing suction-valve actuating-gear the quantity of fuel-oil pumped was in excess of that required.

It will be seen that with the modified sprayer lower fuel-consumptions were obtained throughout, and the exhaust water was clear excepting during the overload test and the 100 b.h.p. and 90 b.h.p. tests with a fuel-valve roller clearance of 0.003 inch.

As the mechanical-efficiency of the experimental engine is slightly lower than a multicylinder engine of the same design it follows that for the same average mean indicated-pressure the b.h.p. of the former will be slightly less than the average b.h.p. per cylinder in the latter. It was thought that a b.h.p. of 100 per cylinder in a multicylinder engine would probably, from the point of view of mean indicated-pressure, correspond to about 95 b.h.p. in the single-cylinder experimental engine, and it was therefore decided to run an additional six hours' test at 95 b.h.p. with the 0.016 inch hole sprayer at 380 r.p.m. and 0.030 inch fuel-valve roller clearance. A slightly heavier shale-oil was used during this test than in the former tests and a ½ inch diameter plunger pump was fitted. The results are given in Table 4, and it will be seen that the fuel consumption recorded is in agreement with the results given for the corresponding tests in Table 3.

(At a later date a test was made with the experimental engine with a sprayer having fine 0.016 inch holes, with flats, with a fuel-valve roller clearance of 0.003 inch, and an average fuel consumption of just under 0.4 lbs. per b.h.p.-hour was recorded when developing 100 b.h.p. at 380 r.p.m. This slight improvement in the consumption was no doubt due to fitting an obturator ring.*)

There should be no difficulty with leakage of connexions so long as substantial fittings are provided, but it is advisable to reduce the number of joints to a minimum. It is imperative that every precaution should be taken to ensure the thorough filtration of the fuel-oil on its passage to the fuel-valve. Although fine filters are fitted occasionally it is found that a choke of one or more holes of a sprayer does occur—especially when the valves and fittings are new. The occasional choking of sprayers on service is probable largely due to pieces of packing working down from the fuel-valve spindle glands, and for this reason, as well as from the point of view of spindle friction, it is advantageous to design the valves so that glands are unnecessary. Pieces of packing from fuel-pump glands also find their way to the sprayers and this points to the desirability of dispensing with packing glands in fuel-pumps as well as in the fuel-valves.

In the experiments referred to in this Paper the best all-round results were obtained with a sprayer provided with five holes 0.016 inch in diameter. Sprayers containing more, and also less, than five holes were tested, but the five-hole sprayer gave the best results within the limits of fuel-pressure which the system as designed was capable of withstanding satisfactorily. All the experiments pointed, however, to the desirability, within practical limits, of using smaller holes and higher fuel-pressures; and had it been possible to employ higher fuel-pressures in the experimental engine there is no doubt that its flexibility would have been increased.

The number and size of the holes in a sprayer depend on the mean pressure in the fuel-injection system; on the viscosity of the fuel-oil; on the mean indicated pressure aimed at; on the distance the jets have to penetrate into the combustion-chamber and also on the speed of the engine. The angle of the holes, i.e. the angle of the cone on which the holes are drilled, is dependent on the shape of the combustion-chamber. So far as the author is aware there are at present no formula which can be used to determine the number, size and angle of holes necessary in a sprayer for a given engine to ensure the best results—it is largely a question of trial and error.

Although generally the fuel-pump worked satisfactorily during the tests, such pumps should, in the author's opinion, be made from forged-steel blocks or steel stampings, when working with fuel-pressures of the order mentioned in this paper.

In a multi-cylinder engine an appreciable reduction in the number of working parts follows the adoption of, what is frequently termed, the "common-rail" system instead of a self-contained system, with its fuel pump, for each cylinder. In the former system a three-throw pump is usually provided which supplies fuel-oil to the common-rail, from which branches are taken to each fuel-valve. Should a fuel-valve act sluggishly with the common-rail system it follows that more than the requisite quantity of fuel-oil will pass in the cylinder in which this fuel valve is fitted. On the other hand, in the case of the single-fuel-pumper-cylinder system (referred to hereafter, for convenience, as the multi-rail system) a sluggish fuel valve will not result in a larger quantity of fuel-oil passing into the cylinder than is sup-

TABLE 3.—RESULTS OF TESTS CARRIED OUT WITH STANDARD AND EXPERIMENTAL SPRAYERS PROVIDED WITH FIVE HOLES, ·019" AND ·016" DIAMETER RESPECTIVELY.

Ref. Letter of Test.	Period of Test. Hours.	R.P.M.	B.H.P.	Fuel Oil. Consumption Lbs. b.h.p.-hr.	Fuel Oil. Pressure. Lbs. per sq. in.	Fuel Valve. Diam. of holes in Sprayer. Inches.	Fuel Valve. Roller Clearance. Inches.	Fuel Valve. Opening before d.c. Degrees.	Initial pressure. Lbs. per sq. in.	Condition of Exhaust Water	Remarks
							100 B.H.P. TESTS.				
A19	1½	379·0	99·8	0·451	2,300	0·019	0·003	26·5	630	Dark.	Higher consumption obtained during Test E19 with the 0·019" hole sprayer is probably due to the valve roller leaving the cam and to the increased energy of the spray at the higher pressure adversely affecting the distribution of fuel oil in the cylinder.
A16	1½	381·5	100·3	0·423	4,200	0·016	0·003	27	630	Shaded.	
B19	1½	380·0	100	0·441	4,300	0·019	0·060	21·5	630	Dark.	
B16	1½	380·5	100·1	0·414	5,800	0·016	0·060	19·5	630	Clear.	
							90 B.H.P. TESTS.				
C19	1½	380	90·3	0·436	2,100	0·019	0·003	31	630	Dark.	
C16	1½	381	90·5	0·417	3,200	0·016	0·003	31	630	Slightly shaded.	
D19	1½	379·3	90·1	0·427	2,400	0·019	0·030	25·5	630	Do.	
D16	1½	381	90·5	0·406	4,000	0·016	0·030	28·5	630	Clear.	
E19	1½	380·5	90·4	0·441	4,500	0·019	0·112	19	630	Dark.	
E16	1½	381	90·5	0·404	5,800	0·016	0·112	21	630	Clear.	
							75 B.H.P. TESTS.				
F19	½	342	75·2	0·428	4,600	0·019	0·112	17·5	630	Clear.	
F16	½	340	74	0·402	5,600	0·016	0·112	19	630	Clear.	
							50 B.H.P. TESTS.				
G19	½	292	48·9	0·491	3,600	0·019	0·112	1	400	Slightly shaded.	Late timing necessary to work at this power
G16	½	292·4	48·3	0·456	4,200	0·016	0·112	0	360	Clear.	
							25 B.H.P. TESTS.				
H19	½	219·3	23·3	0·604	1,400	0·019	0·112	0	340	Shaded.	Fuel by-passed on discharge side
H16	½	224	23·8	0·531	1,800	0·016	0·112	0	340	Clear.	
							MAXIMUM OVERLOAD TESTS.				
J19	½	381	117·5	0·51	3,900	0·019	0·003	22	630	Black.	
J16	½	384	121·3	0·455	5,900	0·016	0·003	22·5	630	Dark.	

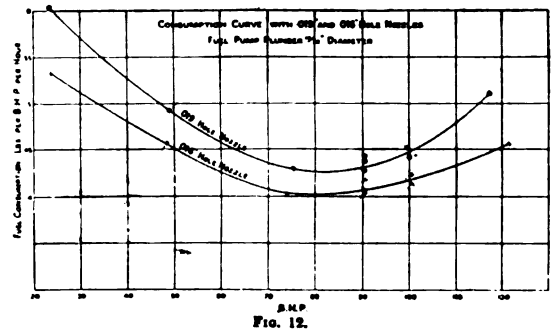

FIG. 12.

TABLE 4.—SIX HOURS' TEST WITH SPRAYER PROVIDED WITH FIVE ·016" HOLES.

Time.	R.P.M.	B.H.P.	Fuel consumption Lbs. b.h.p.-hr.	Remarks.
16 June.				
7·5 p.m.	—	—	—	*Compression pressure*: 380 lbs. per sq. in.
7·35 ,,	380·5	95	0·411	*Opening of fuel valve before d.c.*: 23·5°
8·5 ,,	379·4	94·8	0·411	*Initial pressure*: 630 lbs. per sq. in.
8·35 ,,	380·2	95	0·409	
9·5 ,,	379·1	95	0·409	
9·35 ,,	381·3	95·3	0·408	*Fuel valve roller clearance*: ·030".
10·5 ,,	380·2	95	0·409	*Fuel oil pressure*: 4,400 lbs. per sq. in.
10·35 ,,	379·4	95	0·409	
11·5 ,,	378	94·5	0·410	*Fuel oil used*: Shale of s.g. ·87 at 60° F.
11·35 ,,	381·6	95·4	0·406	*Exhaust water*: Clear.
17 June.				
12·5 a.m.	379·8	95	0·408	*Fuel valve spring load*: 750 lbs.
12·35 ,,	379·9	95	0·408	
1·5 ,,	378·9	94·7	0·410	
Average	379·8	95	0·409	

* Tests were subsequently carried out with a compression of 440 lbs. per square inch, and it was found that a slight improvement in the fuel consumption was obtained, but it was not very marked, being of the order of 0.005 lbs. per b.h.p. per hour.

* During the tests previously referred to the piston of the experimental engine was fitted with six cast-iron rings and one scraper-ring. Subsequently the ordinary piston rings were removed and a phosphor-bronze obturator ring of L section, 1·2 mm. in thickness, was fitted in the fourth groove from the top and a cast-iron ring, which was designed to give a radial pressure of about 1 lb. per square-inch, was fitted in the first groove with the object protecting the obturator-ring from the rush of hot gases. The fitting of the obturator-ring resulted in increasing slightly the mechanical-efficiency of the engine.

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plied by the pump. Further, with this system, should a fuel sprayer be partly choked it will be clearly indicated by the pressure-gauge, and there is also the possibility of the increase in pressure clearing the restriction; whereas a choked sprayer in the case of the common-rail system will not be readily detected, and it will result in overloading slightly the remaining cylinders. The principal objection to the common-rail system, in the author's opinion, is the possible results which may follow the sluggish closing or "sticking" of a fuel-valve spindle; but should the fuel-valve design be such that the chances of seized spindles are remote, then the system has many points in its favor. These remarks are intended to apply to high-speed engines of comparatively low power per cylinder. In the case of an engine consisting of a small number of cylinders of comparatively large power the author would prefer, in the present state of the art, to fit the multi-rail system.

In existing standard submarine engines fitted with the multi-rail system it is possible to change to the common-rail system by means of the hand charging connexions. It has frequently been stated that when an engine running on the multi-rail system is changed to the common-rail system it appears to work more smoothly. This is no doubt true. Various reasons have been put foward to account for this, but, in the author's opinion, the smoother running is due to the fact that with the multi-rail system it is not readily possible, with the fuel pumps used, to ensure that the same quantity of fuel-oil is delivered to each cylinder; whereas with the common-rail system, with all sprayers clear, etc., the fuel-oil is more evenly distributed—which results in each cylinder doing an equal share of the work.

*Fig. 13 will be given with the next installment.

In view of the experience obtained with the direct-lift fuel valve it was decided to design an automatic valve which would completely control the fuel-spray, and which would also avoid the necessity of fitting a spindle gland—thus reducing the chances of the valve sticking in the open position or closing sluggishly.

Many engines of the semi-Diesel and low-compression types have been running successfully for some years with solid-injection automatic valves. Theoretically these valves have an advantage over the direct-lift type of valve. Perhaps this advantage is not so marked when using distillate oils, e.g., shale fuel-oil, but the automatic-valve is likely to prove of greater value when other brands of fuel-oil have to be dealt with. It is usual in engines fitted with automatic valves for the fuel-pump to time the instant of injection; and the fuel-pump discharges the fuel-oil, against a pressure not less than that to which the automatic-valve is loaded, during the time the engine-crank passes through a comparatively small angle. This means that the effective stroke of the pump-plunger is small and consequently the area of the pump-plunger must be made correspondingly larger. This, in large engines, brings a heavy momentary load on the camshaft (assuming that the fuel pump is driven from the camshaft) and the gears have therefore to be of stouter design to withstand it. In the case of the single-cylinder experimental engine already mentioned it was extremely doubtful whether the existing gears would stand up against such a load any length of time, and with the object of overcoming this difficulty a valve was designed on the lines of that shown in Fig 13*. With this arrangement the automatic valve is controlled by means of the mechanically-operated spindle or stop A so that the ordinary fuel-pump can be used. To operate the valve a lever (not shown in the figure), actuated by the ordinary fuel-cam, lifts the spindle A against a spring which corresponds to the spring in the direct-lift type of fuel valve. The fuel-pressure in the solid-injection system acting on the piston D then lifts the automatic valve, which is loaded by spring E, and fuel is sprayed into the cylinder. The closing of the automatic valve is brought about either by the fuel pressure falling below that necessary to keep the valve lifted or by the closing movement of the spindle A. It will be seen that the fuel pressure available for spraying is not less than the loading on the valve due to the spring E; and this is a distinct advantage, especially when running at low powers.

In the direct-lift type of solid-injection fuel-valve the spray is obtained by forcing oil at high velocity through small holes in a sprayer; and the pressure available for producing velocity is controlled by the valve. When the valve commences to lift this pressure, due to wire-drawing past the seat, etc., is less than that available in the system, with the result that the spray at the commencement of injection is probably not particularly good. In a similar manner when the valve closes the pressure in the sprayer gradually falls and it seems reasonable to assume that the last drop of oil goes into the cylinder in the form of a dribble. For this reason it is desirable to close the valve as rapidly as possible. The defects of this type of valve are more marked as the speed of the engine is reduced or the lift of the valve decreased—both of which have an adverse effect on the quality of the spray. This, as already mentioned, is likely to be of greater importance when oils are used which do not come under the heading of "clean" oils.

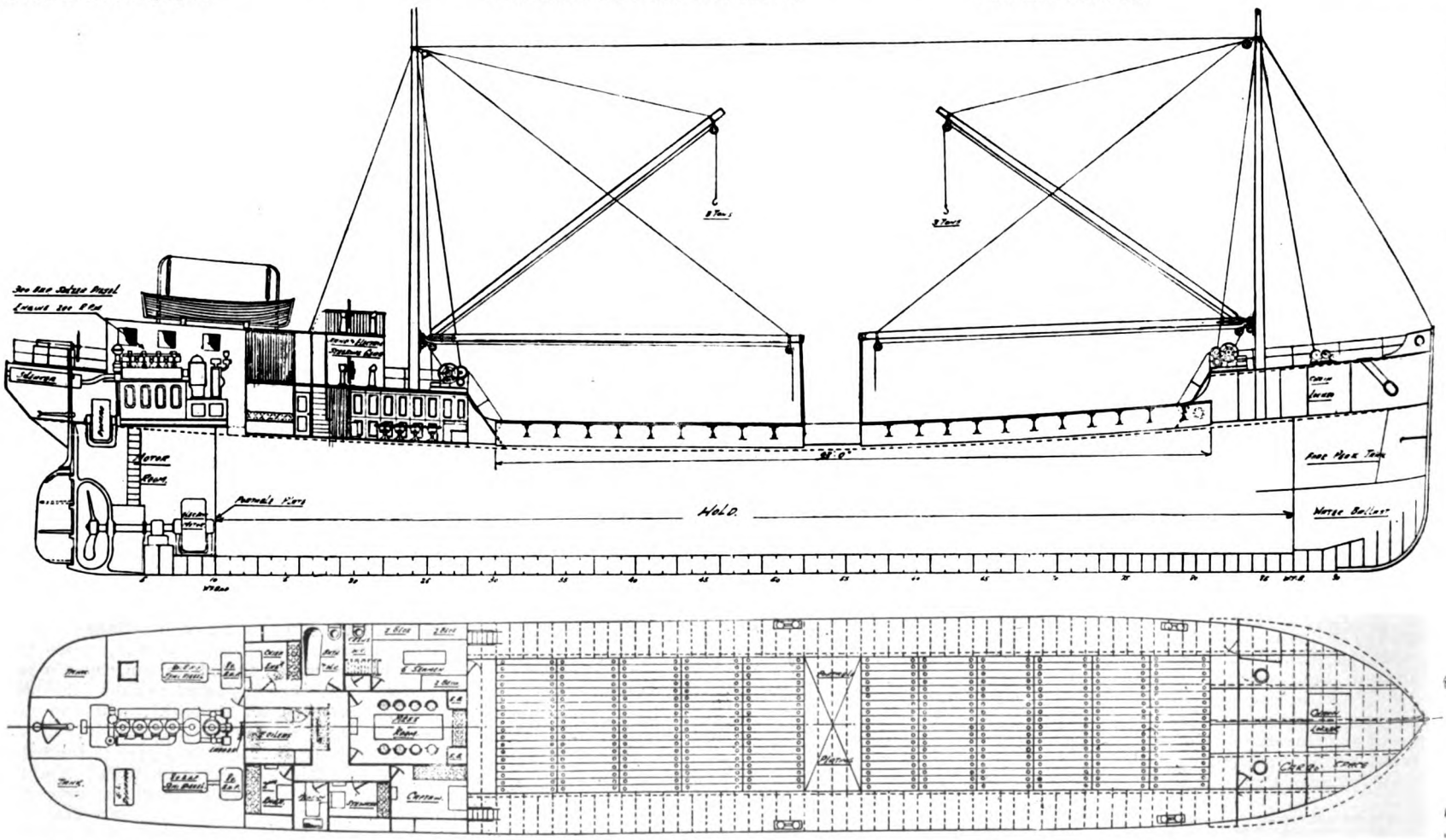
(To be continued)

DIESEL-ELECTRIC DRIVE IN COASTWISE VESSEL

Now building in England is a very interesting motor-vessel for coastwise trading in which Diesel-electric drive will be installed as propelling power. She is under construction at the yard of Dibbles (1918) Ltd. Bellvidere, Southampton, by designs from Robert MacGregor. The construction of a sister motorship has also been commenced in connection with the transportation of barges, the hull being divided longitudinally, as already referred to in our pages.

The ship with Diesel-electric drive is propelled by a 300 b.h.p. Sulzer Diesel-engine driving a generator, this set being installed in the deck-house aft with the electric propelling-motor in the compartment underneath. In the lower engine-room there are also two surface-ignition oil-engines of 80 b.h.p. each driving generators. These two oil-engines can be used as auxiliary propulsion of the ship and a speed of 5½ knots obtained with the two auxiliary motors working alone, or 8 knots if the main engines are running, or 9 knots with combined power.

One auxiliary motor can be hand or air-started, and then serves to start the other, and one or both of them start the larger main engine, which is of high-speed type, so that no heavy starting-bottle, compressors or reversing-gear is required for this engine. The electric-motor on the propeller-shaft is reversible. The vessel carries nearly 20 per cent more cargo than a vessel with the ordinary steam-set, whilst her consumption is only about 2 tons of oil per day under full power. For discharging the cargo there are four electric-winches and four derricks.



Novel arrangement of Diesel-electric drive for new coastwise vessel now building. The two auxiliary surface-ignition oil-engines can also be used for propelling power

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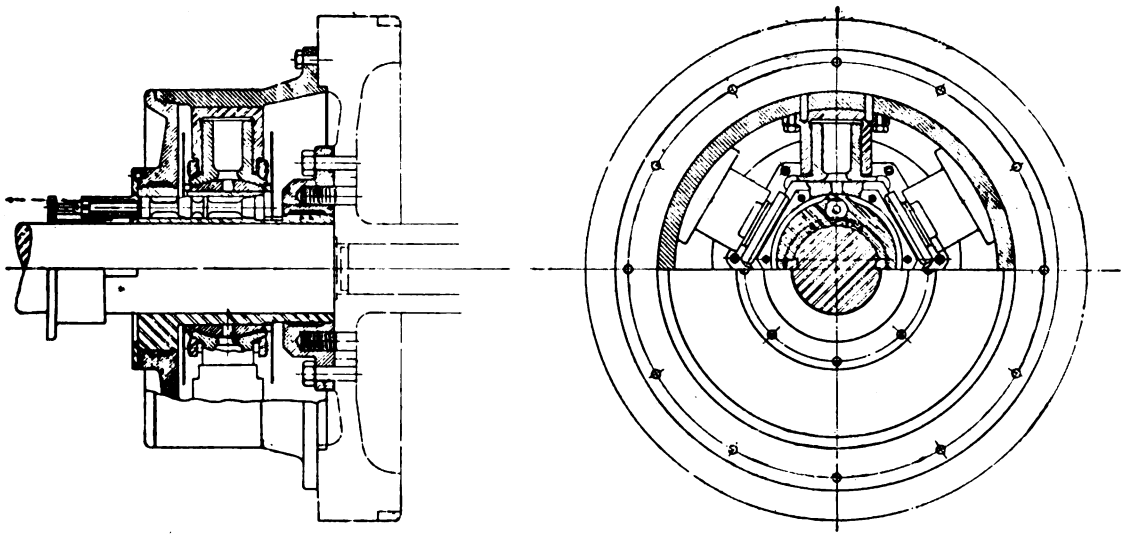
High-Powered Hydraulic-Clutch for Diesel-Driven Tankers

Possibilities of Use of New Hele-Shaw Device for Motorships — Tested on 1,200 B.H.P. Diesel Engine By British Admiralty.

ONE of the "objections" raised by some oil-companies against the adoption of Diesel-engines for tankship propulsion has been the necessity to install a complete set of additional auxiliary machinery for operating the cargo pumps. This could be overcome by utilizing a new design of hydraulic clutch perfected in England from Dr. H. S. Hele-Shaw's designs by W. H. Dorman & Co., Ltd., Stafford, which has been brought to our attention. If any American concern is constructing a similar product we will be glad if they will communicate with us.

If this clutch were interposed between one of the main engines and the propeller shaft, it would be a simple matter to disconnect it when in port, and by means of similar clutches forward, the Diesel engine could at once be connected to the cargo-pumps. Of course, in this event the pump-room would be arranged just forward of the engine-room and the shafting carried through bearings in the bulk-head. An additional advantage would be gained, as the hot exhaust-gases from the main engines could be run under a donkey-boiler both at sea and in port, and the steam thus generated run through the coils in the cargo-holds and fuel-bunkers, always keeping the oil in a fluid state for pumping, as when pumped into the ship it would be warm and sufficient steam could be obtained from the exhaust-gases to maintain the oil-cargo in a fluid state until discharged.

This clutch, which we illustrate, can hardly be regarded as experimental, as it has been thoroughly tried-out, including with success on a 1,200 b.h.p. Diesel engine by the British Admiralty. It can be made in sizes from 10 b.h.p. to 100,000 shaft h.p. In large powers its dimensions are very small, being only 4 ft. 8 in. diameter for 2,000 b.h.p. It is of the oil-transmission type, with no wearing parts or surfaces, is noiseless and vibrationless, and there are no wearing parts or surfaces. Control is by a single central valve. It consists of a series of cylinders and pistons working with oil as the fluid. Its pistons are reciprocated in the cylinders by means of cam mechanism incorporated in one of the shafts. The other shaft (or loose pulley) has a casing fixed to it, which serves the double purpose of holding the cylinders and constituting a reservoir for the operating oil. The chief essential is a series of valves operated from the outside and controlling the passage of oil either between the respective cylinders or between the cylinders and the interior of the casing. If thse valves are open the oil flows freely in the system, and there is nothing to prevent the casing with its cylinders revolving while the other shaft with the cam mechanism remains stationary, in which case the pistons are reciprocating freely in the cylinders. If, however, the valves are closed the oil is locked and cannot flow so that for all practical purposes the casing might consist of a solid casting forcing round the other shaft by means of the cam mechanism.



Dorman design of Hele-Shaw hydraulic-clutch for marine Diesel-engines

It can be more accurately controlled than a friction-clutch. As the valves are closed the oil has a greater difficulty in passing, this raises the pressure in the cylinders and the pistons begin to reciprocate more slowly as the other shaft approaches the primary one in speed. If the valves are closed the pistons do not reciprocate at all and the clutch is transmitting full power. Should the valves be slightly opened and the oil pressures still remain high, but some of the oil is permitted to flow and this allows the pistons to slowly reciprocate and so the one shaft revolves at a slightly slower speed than the other. The measure of the loss in horse-power is the pressure on the oil multiplied by the area and travel of the pistons. Obviously it is possible to operate valves with very small openings and so slip the clutch very slowly and very definitely this being impossible with a friction-clutch.

The difficulty of the heavy pressure on the eccentric is completely overcome as all rubbing surfaces are lubricated by oil at the same pressure as the oil in the cylinders themselves. This is a feature of the greatest practical importance as in consequence very high pressure may be employed, making a small compact clutch and eliminating all wear. This high oil-pressure may be even led to the bearings, thus enabling it to run for a month out of gear as it is completely self-lubricating.

In the Dorman design the method of freeing and keeping the cylinders from air or oil vapour is efficient. There are two main systems employed depending on the conditions required. In one case the pistons during the suction stroke separate slightly from the face it slides on. In the other the piston is always in contact with this face but as it slides to and fro (under the influnce of the cam mechanism) a port is uncovered or a valve opened on the suction-stroke. This port or valve communicates with the reservoir of oil in the casing, so that oil can flow into the system from the casing. This refilling is necessary owing to the slight leakage of oil which must result as a consequence of the heavy pressures.

REVIEWS.

We have received copies of the following publications from the American Society of Mechanical Engineers, 29 West 39th St., N. Y. C.:

"The Diesel Engine and Its Application in Southern California"—By Walter H. Adams.

"Discussion of Certain Problems in Regard to Marine Diesel Oil Engines"—By John W. Anderson.

"Crude-Oil Motors vs. Steam Engines in Marine Practice"—By J. W. Morton.

These are pamphlets that are reprints from papers read before the Society.

NEW EDITION OF DIESEL ENGINE BOOK.

A new and revised edition with appendix of "Marine & Stationary Diesel Engines" by A. H. Goldingham, M. I. M. E. etc., is now ready for distribution. The previous edition having been quickly exhausted and as many unfilled orders were still on the books, a new edition was required. This book is of a thoroughly practical nature and treats of design and construction as well as of the operation and correction of Marine and Stationary Diesel Engines. Although enlarged with an appendix on the foundry practice of Diesel Engine piston castings, the price ($3.00) is the same as that of the former edition.

NEW BOOK ON SUBMARINES.

Though not a text-book for the engineer's library, "Le Lous-Marin," just published in Paris, is a useful historical narrative of submarine invention, development and use. It serves the purpose of presenting from a national standpoint other than our own the various contributions made to the art by engineers of other countries, and of course this volume gives prominence to French accomplishments. The narrative is continued down to the end of the war. In the familiar paper cover of the French libraries and issued at 7 frs., this book costs today about 50 cents, plus mailing charges and duty. Author, G. C. Toudouze; publishers, Librairie Alphonse Lemerre, 23-33 Passage Choiseul, Paris.

BOOK ON LUBRICATION

It is not often that useful technical information regarding lubricating-oil can be had gratis, particularly where issued regularly in the form of a magazine or booklet. Readers of "Motorship" will certainly be interested in the publication known as "Lubrication" issued by The Texas Company which can be had by merely dropping a line to them at 17 Battery Place, New York. This publication is issued regularly and contains valuable technical information based on practical operating experience. On page 450 of our May issue there is a coupon which properly filled-out will ensure our readers receiving regular copies of this publication without charge.

OUR REGISTRY OF MOTORSHIP ENGINEERS.

B. W. Becks, member of M. E. B. A. No. 82, Bath, Maine, address 427 Broadway, Bayonne. Has license for chief-engineer unlimited motorship tonnage. Diesel-engine experience dates back to 1907 in stationary work, but for 5 years has been motorship engineer. Is machinist by trade. Was second-assistant on "Texaco 145," and chief-engineer on "Texaco 125."

John L. Nelson, 2758 Filbert St., San Francisco, Cal. Unlimited license, was second-assistant engineer on Norwegian motorship "H. C. Hansen," and has had altogether about 8 years' experience on internal-combustion engines.

HOLLAND-AMERICA COMPANY'S MOTOR LINERS

Referring to the large motor-liner building at Harland & Wolff's to the order of the Holland American Line, first announced in "Motorship," we are advised that two Diesel motorships are on order, both similar to the "Glenogle" of the Glen Line, and will carry principally freight, also a few passengers. Twin 4-cycle Burmeister and Wain 3,300 i.h.p. Diesel engine will be installed, and the vessels will be of 14,000 tons d.w.c.. Length 502 ft., breadth 60 ft., speed 13½ knots.

PROPOSED MOTORSHIPS FOR THE DUTCH EAST INDIAN GOVERNMENT.

Recently Mr. R. G. Leegstra arrived in the United States from the Dutch East Indies, with a view to having some Diesel-engine propelled patrol-vessels built in this country for the Dutch East Indian Government. However, he advises us on account of the prices in the United States being out of proportion in comparison with the building costs in Europe, the possibilities of placing an order for these motorships are very small at the present time.

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Diesel Power for Passenger-Freighter Liners

Advantages of Oil-Engine Propulsion in Ships of the Combination Type

SEEING that over half-a-dozen of the leading Diesel-engine builders have now standardized twin-screw marine-sets of 6,000 horsepower, and that several American & European companies are constructing, or are ready to construct with the regular guarantees twin-screw Diesel sets up to 10,000 shaft h.p. there is no reason why all combination passenger-freighters now laid down cannot be internal-combustion engine powered, with the resulting of an enormous annual saving of fuel-oil.

Such vessels as the "Panhandle State," "Albania," etc. certainly should never have been steam-driven, because there is no technical or engineering reason why they could not have been successfully powered with Diesel-engines, because they come within the limits in power of a number of leading makes of Diesel-engines.

Undoubtedly there is a great future for the motor-driven "expess freighter" and for the motor-driven combination passenger-cargo classes of ships, as with Diesel-power good speeds such as 15 and 16 knots can be maintained without the fuel-consumptions exceeding those of 11 to 12-knot geared-turbine steamers of similar dimensions.

In order to give a comprehensive conception of the economies possible with the combination passenger-freighter type of vessel, we give herewith some approximate figures regarding the Cunard Line's new oil-burning geared-turbine liner "Albania," together with the operating figures of a sister hull if the same were propelled by Diesel oil-engines of average design.

As a basis for fuel-consumption we have taken 1 lb. of oil-fuel per shaft h.p. hour for the "Albania," because this figure is rarely bettered in actual service over several voyages. Whereas, for the motorship we have taken 0.42 lb. per shaft h.p. hour in order that two-cycle engines may be included in the comparison, as well as four-cycle sets.

Furthermore, after several months or even after several years service, the consumption of a Diesel-engine is nearly always reduced, whereas this is the opposite with steam-machinery, the latter even changing during a voyage. The following are the comparisons that we have figured-out from data available to us.

chinery alone is about 30% higher in first cost at the present time.

While we feel convinced that it is only a matter of a very short time before Mexican, Texas, Russian and Taraken residual-oils, and tar oil will be generally used as motorship fuel, and that it is only the question of training good engineers and giving them bonuses when steady operation is maintained on heavy residual-oils, we have nevertheless quoted the motorship as using a grade of oil at present costing $4.50 per ton more than the heavy-oil used by the S.S. "Albania," yet the Diesel-drive effects a saving of $15,642.00 per round transatlantic voyage, or say $93,852.00 per annum.

This alone is sufficient to mean a difference between profit and loss to a shipowner in bad times. But there are other gains to be effected. Namely, the absence of boiler-water and the great reduction in the quantity of fuel to be carried enables the motorship to carry about 1,670 tons more cargo than the steamer, or a possible extra earning power of close upon $15,000 per one-way voyage, or $180,000 per annum if fully-loaded each way every voyage with cargo at $10.00 per ton and with six round voyages every year.

This gives a gain of approximately $273,852 per annum in favor of Diesel drive. Then again the benefits of no firemen or trimmers must be a great boon and will avoid many a sailing delay with its loss and should enable about ten more passengers to be accommodated.

With some makes of Diesel-engine, such as the North British, Burmeister & Wain, McIntosh & Seymour and Worthington, it is possible that the machinery may weigh a little heavier than a geared-turbine plant, and occupy nearly the same space, but not if the boiler-water supply and water-in the boilers are taking into consideration as they should be to make a fair comparison.

On the other hand with such Diesel-engines as the Sulzer, Werkspoor, Ansaldo-San-Giorgio, Doxford, Cammell-Laird-Fullagar, both weight and space are less compared with geared-turbine plants of the same power, without takjng the boiler-water into account.

The weight and dimensions of the leading designs of Diesel engines of this power vary as much as 15 ft. overall and 250 tons in weight, as will be

Estimated Comparison Between the New Cunard Combination Passenger-Freighter "Albania" and a Sister Motorship

(Fuel-Consumptions Based on 1.00 lb. and 0.42 lb. per shaft horse-power hour respectively, the steamer using cheaper oil).

	S.S. "ALBANIA" (Geared-Turbines)	SISTER MOTORSHIP (Diesel Oil-Engines)
Length B.P.	522 ft	522 ft.
Breadth M.D.	64 ft	64 ft.
Depth M.D.	46 ft., 9 in	46 ft., 9 in.
Power	6,800 shaft h.p	6,800 shaft h.p.
Deadweight Capacity	12,000 tons	12,000 tons
Net Cargo-Capacity (less fuel, water & Stores)	9,400 tons (approx.)	11,070 tons (approx.)
Fuel	Crude-oil	Diesel-oil
Cost of fuel per ton	$15.50	$20.00
Daily Fuel-Consumption at Full Power	73 tons	20½ tons
Daily Fuel-Consumption in Port	15 tons	2 tons
Daily Fuel-Bill	$1,181.50	$490
Fuel-Bill for One-Way Voyage (11 days) and 4 days in port	$13,371	$5,550
Passengers Accommodated	480	490
Number of Firemen and Trimmers	11	None
Bunkers for 35 days (incl. 8 days port-consumption, 22 days at sea and 5 days sea-reserve)	2,190 tons	570 tons
Total Fuel-Bill for 22 days at sea and 8 days in port	$26,742	$11,100
Boiler-Water Carried (included in Dead-weight-capacity	200 tons for main boiler	25 tons for donkey-boiler
Total Weight Drinking-Water and Stores (included in the dead-weight-capacity)	210 tons	210 tons

Although the steamer costs about 10% less to build, the complete motorship is actually slightly cheaper to construct per net-ton of cargo carried, because she carries over 12% more cargo and more passengers on the same hull dimensions and quantity of structural steel. The Diesel machinery alone is about 30% higher in first cost at the present time.

While we feel convinced that it is only a matter of a very short time before Mexican, Texas, Russian and Taraken residual-oils, and tar oil will be generally used as motorship fuel, and that it is only the question of training good engineers and giving them bonuses when steady operation is maintained on heavy residual-oils, we have nevertheless quoted the motorship as using a grade of oil at present costing $4.50 per ton more than the heavy-oil used by the S.S. "Albania," yet the Diesel-drive effects a saving of $15,642.00 per round transatlantic voyage, or say $93,852.00 per annum.

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The weight and dimensions of the leading designs of Diesel engines of this power vary as much as 15 ft. overall and 250 tons in weight, as will be seen from the table in our April issue. We have noticed that most comparison articles produced by other than those of our staff have always taken the heaviest Diesel-engine on the market as a basis for their figures instead of taking a fair average design.

BOOK REVIEWS

Hilfsbuch Fur Den Schiffbau, by Johow and Foerster. Published by Julius Springer, Berlin. We have received a copy of the 1920 edition of this well-known book on naval architecture and shipbuilding. This edition is in two volumes, a second volume being necessary for the 645 illustrations and 32 tables, many of which are folding plates, including all the plans of vessels. Unfortunately our personal knowledge of the German language is far too limited for us to attempt a review, but as it happens this work is far too well-known to need review. The latest issue has been brought up to date, except that it contains very little motorship matter.

Cooling and Quenching of Oil and the Heat Treatment of Steel, by Kenneth B. Millett.—This interesting 29-page brochure describes the necessity for heat treatment, the various quenching mediums and systems commonly used, the advantages of continuous circulation of the medium and the excellent adaptability of the Multiwhirl Cooler to the cooling of quenching oil. Typical installations are featured, showing the layout of the piping with recommendations for the proper size and number of coolers to meet the requirements. It has been published by the Griscom-Russell Co., 90 West Street, New York City. Copy will be sent upon request without charge.

LITERATURE ON ELECTRIC BRAKES

Electrically-Operated Brakes are described and illustrated in a 16-page, 8½ x 11 booklet with the above title, and published by the Cutler-Hammer Mfg. Co., of Milwaukee, Wisconsin. Publication 850, as the booklet is known, takes up shoe-brakes for both direct and alternating current service. Tables give dimensions and ratings of each type of brake, and it is explained how the correct size of brake for any particular installation may be calculated. The direct-current shoe-brake is described as being very compact with low head room, and operates with a direct magnet action. Its rigid construction and few moving parts make it adaptable for the most severe service. The alternating-current brake operates by means of a rotating magnet, which largely eliminates noise and wear.

ITALIAN DIESEL WARSHIPS

"Jane's Fighting Ships 1920"—Published by Samson Low, Marston & Co. Ltd. Price £-2-2-0. Probably this latest edition of Jane's well-known naval book is the most interesting ever published, as it contains illustrations and details of practically all surface warships and submarines constructed during the war. Also, the British Admiralty have allowed illustrations of their capital ships to be reproduced once more, all silhouettes and photographs having been eliminated during the war period.

To Diesel-engine builders the Italian section will be of particular interest, as some very interesting oil-engined war-craft are illustrated, to which references were first made in "Motorship" early in 1918. There are four classes of surface-craft propelled by Diesel-engines. The "Grappa" class consists of four vessels of 575 tons, "Montello", "Grappa", "Monte Moregno" and "Monte Cengio", and carrying one 15 in. gun and one Colt M. G. They are propelled by twin 350 shaft h.p. Ansaldo-San Giorgio Diesel-engines, and were built at the Castellamere Dockyard from designs by Major-Gen. G. Pruneri.

The "Faa di Bruno" class are box-shaped monitors, or "mobile batteries", with two 15 in. guns, two 14-pounders and two 1½-pounders, but are only of 100 b.h.p., one Diesel-engine being fitted. Over three years ago we were privileged to see "moving-pictures" of this vessel in action against the Austrian coast.

The "Carso" is another Diesel-driven gun-vessel. She is of 360 tons and is propelled by two 300 b.h.p. Polar-Diesel engines. She carries two 7.5 guns. Like the "Faa di Bruno" she was built at the Venice dockyard.

Then there is the "Monte Santo" class consisting of two vessels, the other being the "Sabotino", with one 15 in. gun each. They are of 540 tons displacement, and propelled by a Tosi 350 b.h.p. Diesel engine. The "Pasubio", "Vodice" and "Cucco" are similar to the "Carso", but carry smaller guns. They were laid-up in 1920.

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First of Fleet of 16 Diesel-Driven Ore Carriers

Launch of the Motorship "Strassa" at Goteborg—To Carry Both Oil and Ore Cargoes

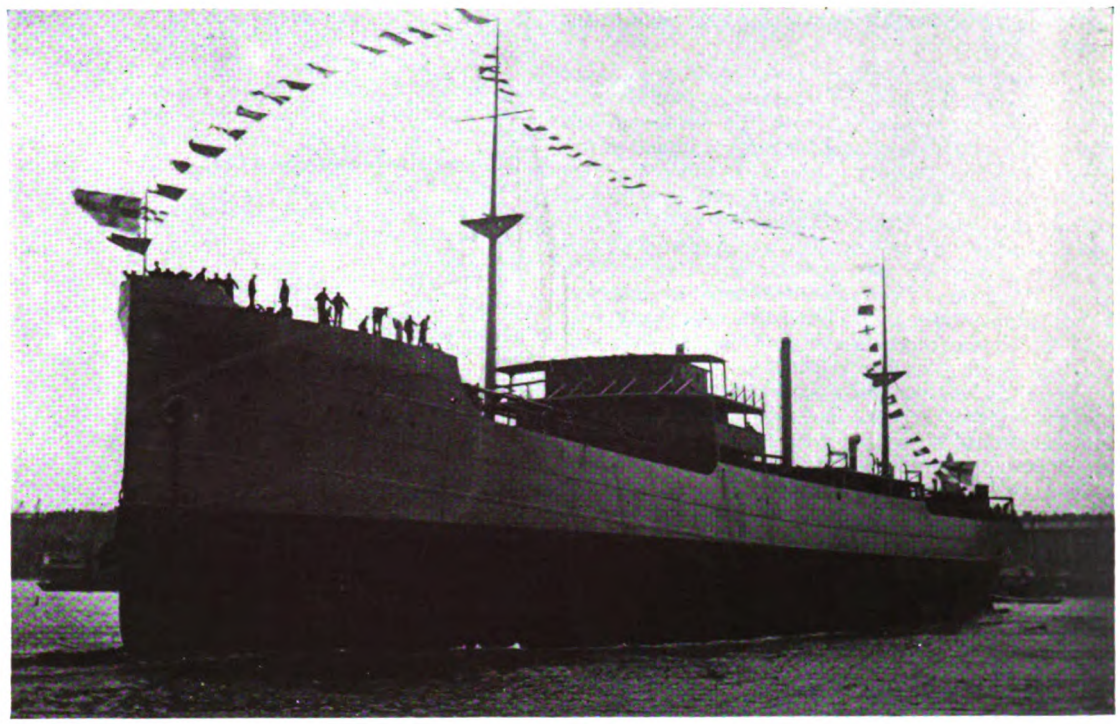
THE third of the 18 ore-carrying vessels which the great Swedish ore company Grängesberg-Oxelösund ordered from Götaverken, at Gothenburg, has now been launched. She was named "Strassa," after the great ore-fields of the company in the middle of Sweden.

The construction of the M/S "Strassa" is in many ways remarkable, and quite different from the two preceding vessels built by Götaverken for this company. It is to be remembered that the two first vessels were steam driven, but that the company after very careful investigation went in for Diesel-motor-drive. A special committee was appointed to investigate which kind of propelling-machinery was the most suitable for the ore-carrying vessels of the company. The committee came to the conclusion that it was not only more economical to have the vessels Diesel-motor-engined, but that it also allows a much better distribution of the load, owing to the engine room being shorter, which has a decided influence on the strength and tends to diminish the stresses in the ship.

The M/S "Strassa" has a shelterdeck and is provided with forecastle and cruiser stern. She is built to the highest class of the British Lloyd. The dimensions are: Length over all, 339 ft. 3 in.; moulded breadth, 53 ft. 5 in.; moulded depth to shelterdeck, 34 ft. ¾ in. Her dead weight is 8,200 tons.

The steam-driven ore-carrying ships have four cargo holds, whereas the "Strassa" has five cargo holds. In order to carry home oil to those of the company's ships which do not go to any oil-producing countries the "Strassa" is provided with deep tanks below the No. 1 hold, going from the bulkhead of the machine room to the peaktank through the whole aft of the ship. The deep and peaktanks have a capacity in all of 1,800 tons of oil. Besides, there is room for 500 tons of oil in the bottom tanks serving as bunker for the ship.

The main machinery consists of two of the Götaverken B. & W. Diesel-motors of 2,600 I.H.P. For the captain's accommodation a deckhouse is erected between No. 2 and No. 3 holds. On the top of this is the bridge. Accommodations of the officers are around the engine-casing. Accommodations of the crew are aft. The ship is rigged with two masts and is in every way modern and up-to-date and will shortly be in service.



Combined ore and oil carrier built and Diesel-engined by the Götaverken for the Grangesberg Company

CONVERSION OF "LUYS CASANOVA"

Now being installed in the sailing-vessel "Luys Casanova" at Barcelona, Spain, is a 320 b.h.p. Atlas-Polar Diesel-engine.

"CHRISTOBAL LLUSA" BEING CONVERTED

Work fitting a twin-screw set of Bolinder oil-engines is now being carried out in the sailing-vessel "Christobal Llusa" at Barcelona, Spain.

ENTERPRISE ENGINE'S 30 DAYS' RUN

In the brief report, on page 402 of our May issue, of the 30 days' test-run of the Enterprise 100 b.h.p. Diesel engine, it was stated that the fuel used was of 40 degrees gravity, instead of 14 degrees. The error of course was a typographical one. In service the engine operates on oil varying from 14 to 26 degrees gravity.

BURMEISTER & WAIN PRODUCTION FOR 1920

During 1920 Burmeister & Wain delivered two motorships aggregating 15,713 gross tons and 7,600 i.h.p. also marine Diesel-engines of 12,720 i.h.p. for motorships built at other yards, while B. & W. licensees completed eleven motorships of 43,000 i.h.p. In addition, they delivered 14 stationary Diesel-engines of 3,160 b.h.p. This makes a total of 23,480 horsepower for 1920.

ROBERT WARRINER'S PAPER BEFORE THE S. N. A. M. E.

Because Mr. Robert Warriner's paper before the Society of Naval Architects and Marine Engineers chiefly dealt with reduction-gears for ship propulsion and only touched lightly upon motorships, we are not reproducing the same, but on this page is a table included in his paper giving comparisons of four types of combination ore and oil-carriers of 20,000 tons d.w.c.

The table shows the relation as to the weight, space, cost and operating expense for reciprocating-engines, turbines and reduction-gears, Diesel, and electric drive on these particular tankers, all of which are twin-screw. In this the Diesel-engine is rather at a disadvantage owing to the necessity of fitting considerable boiler power for heating the cargo-oil. We think that the daily consumption of 24 tons for the motorship would be very much lower if the exhaust-gases were used to generate steam for maintaining the cargo in a fluid state when at sea; because, at some oil-docks the ship's boilers have to be drawn and steam supplied from shore stations. This would then give the motorship a daily consumption of 14½ tons, and so will effect a big saving, and automatically increase her carrying capacity.

	Reciprocating	Turbine	Diesel	Electric Drive
Speed of ship, knots	11.5	11.5	11.5	11.5
Diameter of propellers	17′ 6″	15′ 8″	15′ 8″	15′ 8″
Revolutions per minute	76	105	105	105
S. H. P. for 250 sea miles per day	4135	4350	4350	4350
S. H. P. maximum	4600	5800	5000	5800
Weight of machinery and water-tons	1060	914	1267	981
Weight of machinery in lbs. per max. S. H. P.	517	353	567	379
Space occupied by machinery, cubic feet	171,826	171,826	192,251	171,826
Total weight of hull and machinery, tons	9350	9200	9700	9267
Net carrying capacity of ship bunkered for 20 days steaming and 8 days' reserve fuel, tons	18,775	19,220	19,482	19,153
Comparative cost of machinery	100	98.3	123.5	128.3
Fuel consumption per day 250, sea miles, tons	60	48	24	48
Estimated cost of operating per day*				
Crew	13.33	13.33	14.46	13.33
Repairs	11.34	11.34	11.34	11.34
Stores	4.82	4.82	7.89	4.82
Provisions	3.97	3.97	4.26	3.97
Depreciation	27.10	27.00	29.83	30.10
Insurance	17.60	17.53	19.40	19.67
General	1.42	1.42	1.42	1.42
Fuel-oil	20.42	16.34	8.18	16.34
Total	100.00	95.74	96.38	100.99
Per deadweight ton	100	90.7	93.2	99.3

* Based on total of 100 for reciprocating machinery.

Comparison table of operating costs of four different types of ships given before the S.N.A.M.E. by Robert Warriner, Chief-Engineer of the Bethlehem Shipbuilding Corp.

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Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement, etc.)

A STEAM SHIPBUILDER AND "MOTORSHIP"

To the Editor of "Motorship,"

Sir:—

You deal with the subject of Diesel engineering, in a broad-minded manner, realizing that it is fundamentally an economic competition between steam-engines and internal-combustion engines for marine propulsion.

After about thirty years' close contact with the building and operation of vessels, of many types, I am strongly impressed with the progress and possibilities of Diesel-type internal-combustion engines in economic competition with steam-engines. I believe the internal-combustion engine will win out in this competition. The rapid advance and refinement of Diesel-engineering in Europe indicates very strongly that we are on the verge of a great transition, from steam-engines to internal combustion engines, especially in merchant vessels for ocean freight service. I believe that motorships will make steamships economically obsolete as rapidly as steamships made sailing ships obsolete. Present and future expensive fuel and operating personnel will force us to design, build and equip vessels in an up-to-date way to reduce the operating cost.

Present maritime transportation in all trades is extravagant and wasteful because of innumerable unnecessary varieties in types, sizes and equipment of vessels, and also because of unnecessary varieties, sizes and shapes of shipbuilding materials. I have no doubt that the world's ocean transport costs can be reduced enormously by standardization of types, sizes and equipment of vessels, and standardization of shipbuilding materials and construction practices. Probably the first great economy to be accomplished will be reduction of costs of fuel and operating personnel through the adoption and use of internal-combustion engines to replace steam-engines. A large movement is already on in that direction, and I believe it will rapidly increase. I understand there is now about 500,000 tons of motorships under construction in the world. This is very substantial evidence of transition from steamships to motorships, and should be especially gratifying to you.

I recall that you were a pioneer in this country, urging the adoption of Diesel-type engines for marine propulsion. You were an enthusiastic champion, and optimistic on this subject, when most of us were skeptical pessimists. I congratulate you for your foresight and good judgment on this subject, and as editor of "Motorship" you are successfully prompting us to a serious realization that American shipbuilders and ship-owners must prepare to meet the coming urgent demand for motorship building and Diesel engineering. I believe that the great majority of the present freight tonnage of all nations is now economically obsolete and must be replaced as rapidly as possible with up-to-date economical ships.

Yours very truly,
WALLACE DOWNEY, President,
Downey Shipbuilding Company.

New York, May 31st, 1921.

THE CREW OF THE M. S. NARRAGANSETT

To the Editor of "Motorship,"

Your article headed "Latest Voyage of the Motor Tanker 'Narragansett,'" which appeared in the May issue of "Motorship," seems to invite comment, especially where Chief Engineer Rawes advised you that when the "Narragansett" was placed in service none of his engine-room crew had previous experience with Diesel engines, with the exception of the engineers from the works and himself.

This is entirely wrong, as the remaining engineers had considerable previous experience on this class of engine, their total experience amounting to over 30 years.

Wishing your worthy paper every success,
Yours very truly,
WILLIAM SLESSOR,

413 St. Vincent Street,
Glasgow, Scotland.

SOLID, PUMP, OR MECHANICAL INJECTION

To the Editor of "Motorship",

The term "Solid Injection" seems to have come into quite universal use in referring to Diesel oil-engines and other similar types, where the fuel-oil is injected into the cylinder by a pump, instead of by the more general use of highly-compressed air.

The term "Solid Injection" is really a misnomer and does not convey the correct idea. There are two principal methods of injecting the fuel-oil into the engine cylinder. One is by highly compressed-air and the other is by means of a pump working against very high-pressure and forcing the oil through the spray-valve in a corresponding manner, as is done by the highly compressed air.

What would be more explicit and convey the correct idea would be to use the term "Pump-Injection" instead of "Solid-Injection." We would then have the two terms "Air-Injection" and "Pump-Injection," each conveying the idea by its name, as to how fuel oil is forced into the engine cylinder.

With the pump injection method the oil is not sprayed into the cylinder in any more of a solid state than takes place with the air injection method, therefore why should this word "solid" be used? In either case, when the oil passes through the spray valve, it is broken up into the finest particles possible. In one case the necessary pressure is exerted by highly compressed air, in the other case it is accomplished by a pump working against very high pressure. The term "Pump Injection" is therefore logical and conveys the idea in its name.

Why, then, not the term "Pump Injection," instead of "Solid Injection"?

Yours very truly,
New York, N. Y. H. R. HOWELL.

WHAT CONSTITUTES A DIESEL ENGINE

To the Editor of "Motorship,"

In your May issue of "Motorship," Volume 6, No. 5, on page 409, there is an advertisement by the Atlas Imperial Engine Company of Oakland, California, on their "Mechanical-Injection 'Full' Diesel-Engine," wherein they explain the engine as follows:

No High-Pressure Air
No Hot-Surfaces
Positive Governor
Low-Compression
Clear Exhaust
100 to 350 Revolution

According to my understanding of the Diesel-engine the above representation of a Diesel-engine is in error. Will you please advise me your understanding of the "full" Diesel-engine and its method of injection and ignition, stating whether or not the engine as advertised by the Atlas Imperial Engine Company is a "full" Diesel-engine?

Thanking you for an early reply to this letter, I am, yours very truly, D. N. WOMMACK,
Southern Engine & Pump Company.

Houston, Texas.

[A very complete discussion of what constitutes a Diesel engine was published in the February and March, 1911, issues of "Motorship." The title of the article was "Oil Engine Nomenclature." We stated that the three fundamental features of the true Diesel cycle are as follows:

(1) Compression of pure atmosphere to a degree that the temperature produced is adequate for the inflammation and combustion of the fuel.
(2) Injection of fuel at such a rate that the burning proceeds without rise of pressure in the combustion space. (This condition is not realized with absolute precision, there always being a slight rise of pressure when the fuel begins to burn.)
(3) The injection of fuel by air-blast that produces turbulence needed for good combustion. (This is essential but not distinctive or exclusive to the Diesel cycle.)

In our March, 1917, issue we gave the opinions of the leading American oil-engine builders as to what constitutes the Diesel cycle.—**Editor.**]

THE MOTORSHIP ENGINEER QUESTION

To the Editor of "Motorship,"

Sir—

I have read with interest the article proposing an "Engineers Registry Bureau" in the March issue of Motorship. There have been several other articles about not being able to get in touch with competent Diesel-engineers.

It seems to me that if the shipowners and the trade in general were informed of the facts of the case such a Registry Bureau is entirely unnecessary and would not be used by the best engineers. There is a society called the Marine Engineers Beneficial Association that has offices in all the main seaports of the U. S. and they are prepared to furnish engineers for steam or Diesel-ships at any time and men who have had experience with Diesel-engines of any size or type. Men who compare with foreign engineers in the same manner that U. S. built Diesel-engined ships or any other U. S. product compares with foreign.

It has been my pleasure to put in 3½ years with one of the foremost marine Diesel-engine firms in the U. S. who have built or building over 500 Diesel-engines from 120 to 1,000 h.p. for U. S., Chile, Spain, England, Russia and others too numerous to mention. During that time I have seen a great many marine engineers come to the shop and put in from 4 months to severals years on the erecting and testing floor for a whole lot less money than they could have received on the ships they had left. These men have put themselves to a great deal of expense to get Diesel experience where it could be acquired in the shortest time.

A great many of these men not being machinists to go work as helpers or 3rd class machinists for the reason mention above and stick to it until they get what they came for. I know for a fact, that this same thing has been going on in other shops around the country and men going after this "on their own hook" are worth as much or more as any other man.

Diesel-engine training ships and schools might be very fine if necessary, but as we have plenty of ex-steam and gas engineers who have gone to a lot of trouble to learn as well as Diesel engineers and machinists who have followed the Diesel business from the very beginning I don't believe such schools and ships are at all necessary.

At the same time I know of a great many steam-engineers who have put in time as oilers on Diesel-ships and with their previous experience have obtained unlimited licenses for Diesel. At the same time we have hundreds of engineers who put in time in U. S. submarines during the war where they were running Diesel-engines averaging twin 500 h. p. and even up to four of 1,000 h. p. in our largest subs.

Trusting that I have shown that we have the goods I will add a word as to where it can be obtained. The Marine Engineers' Beneficial Association is what its name implies and is not a radical society under the name of a labor union as some of the propaganda that has been in circulation tries to make the public believe all Associations are. Any time you go down in the engine-room of any U. S. steam or Diesel ship you will see the engineers with a little button on their shirt collar with a propeller and the letters M. E. B. A. No.—— and V. and F. on it.

Any ship-owner who gets his engineers through the M. E. B. A. (as do the Standard Oil Co. and all the other big operators) and find such engineers incompetent they have the privilege of sending them back with the facts of the case, and the Association, if the facts warrant will gladly furnish others who are competent.

The trade in general should not forget that all Diesel-engineers are licensed by the U. S. Steamboat Inspection Service and anyone who thinks it is easy to get a License I would advise them to go to an Inspectors Office and ask to see a set of questions—answers and experience that was written out by some Diesel engineer when he was up for examination.

Hoping this will meet with your favor and help to put the U. S. Diesel-engined and American operated ships on the map, I remain

Yours very truly, GEORGE W. HAGGETT.
Chief-Engr. M. S. "Ambassador."
Member M. E. B. A., No. 52, Seattle, Wash.

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